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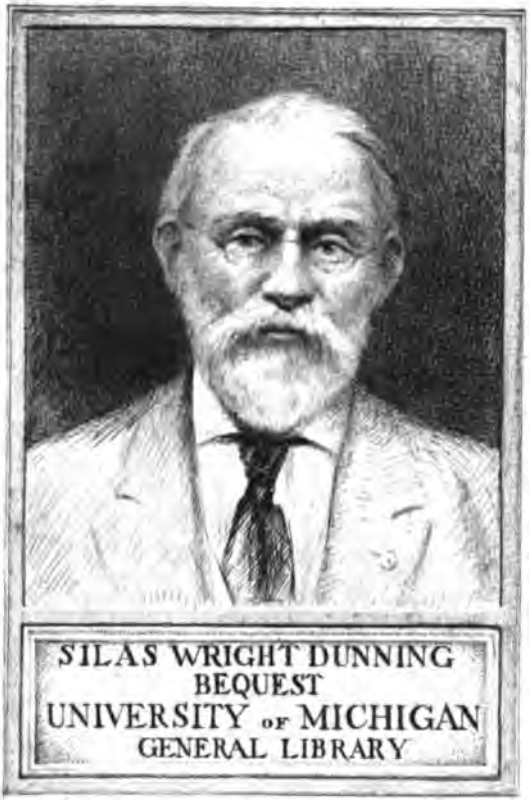

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THE

TRANSACTIONS

OF THE

BOMBAY GEOGRAPHICAL SOCIETY.

FROM MAY 1857 TO MAY 1858.

(NEW ISSUE.)

EDITED BY THE SECRETARY.

VOLUME XIV.

BOMBAY:
SMITH, TAYLOR & CO.

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PREFACE.

The publication of the Transactions of the Geographical Society has of late year fallen into someting like confusion, for which some explanation is requisite, by the late Secretary and Editor.

A large portion of the sheets, of No. XII. the number last issued had passed through the press in 1856, when I found myself unexpectedly compelled to visit England. I was absent from January to October 1857, when it seemed so desirable to expedite publication as much as possible, that "the reports of the proceedings" usually forming a section by themselves preceding the papers, was omitted. The present issue in consequence embraces the proceedings of two years and the papers of another,—occasioning an apparent confusion—the cause and the nature of which requires to be explained.

Having changed our printer we found we had committed ourselves to an establishment which could not boast of either celerity or correctness, and the want of the latter the reader will readily comprehend as to the former, it is sufficient to say that close on two years have been occupied in passing 140 pages through the press.

Neither of these annoyances will, it is hoped, require a second time to be apologised for.

Though no longer Secretary to the Society I have been premitted to continue my editorial duties till the publication of the present number was completed, the preparation of which I commenced ; and have now to take a final, respectful, and affectionate leave of those who have for sixteen years been the most indulgent of constituents.

GEO. BUIST.

Bombay, 4th August 1859.

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CONTENTS.

PROCEEDINGS.— Pages.

1855. August 15.—Experiments on Subsurface evaporation. On the opposite movements of the lower and upper strata of clouds by the Secretary ..... i-iii
Sept. 20.—Certain Peculiarities of Water Plants in our Tanks. v
1856. January 17.—On the Physical Geography of India ..... vi-xxi
April 17.—On Skeleton Charts. The Beaufort Testimonial. xxii
August 21.—Value of Barometric Measurements xxv
October 16.—On the Axial Rotation of the Moon xxvii
Dec. 16.—On the Earthquake in the Levant, 12th October 1856. Correspondence in reference to Captain Burton's Expedition ..... xxxi-xli
1857. Feb. 19.—On Foucault's Experiments on the Rotation of the Earth Dr. Sinclair xlii
April 24.—On the Ferns in the Western Ghauts Mr. Leggat xlv
May 7.—Annual Meeting Report iii

PAPERS.—

ART. I.—Physical Geography of the Red Sea. By DR. GEO. BUIST, L.L.D. F.R.S. L. and E. &c ..... 1—40
ART. II.—On the Geology of the Rock of Gibraltar. By DR. GEO. BUIST, L.L.D. F.R.S. L. and E. &c.... 46—49
ART. III.—On Professor Owen and Mr. Horner's Views, of the Age of Man upon the Earth, as laid before the British Association Sept. 1858. By DR. GEO. BUIST, L.L.D. F.R.S. L. and E. &c. read 19th Nov. 1858.... 50—57

APPENDIX.—

Date of the Elephanta, 1 to 5—Average Occurrence of Hurricanes in the Eastern Seas, 5 to 8—The Gunpowder Plot Storms, 8—The Readings of the Barometer for the Second week in June from 1850 to 1858, 8 to 11—Extraordinary Appearance at Sea, 11—Experiments on Salt, 11—Luminous Meteors, 12—Venomous Snakes, 13 to 14—Appearance of a Tiger on the Mazagon bunder, 14 to 15—Silk Cotton Trees, 15—Ashes of eastern timber trees 15 to 17—Cultivation of Tea in India, 17—Curious Discovery in the South Atlantic, 17 to 18—Floods on the Indus, 18 to 20—Shipwrecks in the Eastern Seas, 20 to 23—Wreck of two Vessels in Torres Straits, 23 to 25—Maldives: Wreck of the "Subahdar" Emigrant Ship 25—Straits:—Wreck of the Swedish Bark "Kare" at Grand Port, 25 to 26—Lac Insect, 26 to 27—The Eggs of Insects, 27 to 28—Earthquake, 28—The Colour of the Planet Mars: a Geological Suggestion, 28 to 29—Original Bombay Observatory, 99—Photographs of Indian Forest Trees, 29 to 30—Labourers employed on the Thull Ghaut 30—A Legion of Locomotives, 30—Firewood Trade, 30 to 38. ..... 1—31

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PROCEEDINGS

OF THE

BOMBAY GEOGRAPHICAL SOCIETY.

1856-57.

The Ordinary Monthly Meeting of the Bombay Geographical Society took place in their rooms on Thursday, August 15, 1855.

PRESENTS—No. XII. of the Bombay Government Records, new series, containing miscellaneous information connected with the Mahee Kanta. Presented by Government.

2. No. XIII. Do. Do. History of Sind ; Do. Do.

3. Memoir of the Province of Bagdad, by Commander Jones, I.N. Presented by Government.

4. No. XIV. of the Bombay Government Records, new series, containing information relative to the Physical character of the Nerbudda. Presented by Government.

5. Report of the Grant Medical College for the Session of 1854-55.

6. 24th Volume of the Journal of the Royal Geographical Society.

7. A Collection of Journals of the Bengal Asiatic Society.

8. Administration of Civil Justice in British India, by Col. Sykes, F.R S. Presented by the Author.

The following letters were laid on the table:—

LETTERS.—No. 2263, 2423, 2969, and 3359 ; from Secy. H. L. Anderson, Esq. ; from C. E. F. Erskine, Esq. ; from the Secy. Royal Geographical Society, London; from John Peet, Esq., Acting Principal, Grant Medical College; from D. F. McLeod, Esq.; from Messrs. Nicol and Co.

The first subject brought before the meeting was the result of an experiment in evaporation, which seemed at one time interesting and mysterious. The evaporation from the surface of water exposed to the breeze, but shaded from the sun, was in Bombay about a quarter of an inch daily during the dry weather; the absolute amount of evaporation could hardly be ascertained while the quantity of water contained in any ordinary sized evaporating dish became so heated in the sun, beyond any mass with which nature presented

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ns, as to show an excess, while that in the shade exhibited a defect in the actual quantity, but was of the two the much more exact mode of experimenting. It became matter of much interest, to know the rate at which the drying of the soil diminished during the fair season as the moisture receded from the surface; and with a view of determining this, a cylinder of tin, three feet in length, and five inches in diameter, fitted up with a glass guage tube at the side, was resorted to. This was filled up with an ascertained weight of carefully dried red earth, and into this was poured as much water as filled the vessel and tube to the brim, the amount being carefully measured and noted. As evaporation proceeded, a regular series of tides made their appearance within the tube, the water reaching its highest about three o'clock, then descending till seven next morning, rising again at three, and so repeating the fluctuation, which ascended about an inch and descended about an inch and a half daily. The experiment was originally made in 1849, and noticed in the *Athenæum* at the time. It seemed so mysterious, that it was this season repeated with the greatest possible care for a period of two months, and after being endlessly diversified, it appeared that the cylinder with its earth and water, after all only constituted a very clumsy thermometer, the earth open as it was, being sufficiently obstructive to cause the fluctuations by expansion and contraction to be observed in the tube. It would have been very unphilosophical to abandon the enquiry so long as a mystery seemed to attach to it, or it promised to be productive of any result of value, and it was persevered in accordingly. The case was one of many constantly encountered, in which weeks or months of anxious labour and investigation were expended without fruits. Publication of details in this experiment became superfluous, as they were simply the records of so much work thrown away, and we appear as yet without any means of ascertaining the fact originally desired to be enquired into.

On Globe or Ball Lightning.—*By the Secretary.*—See last Transactions, No. xiii p. 148.

On the Movement of the Clouds in the Upper and Lower Regions of the Air.

Dr. Buist stated that he had been for some time engaged in investigating this subject, and had at the present juncture brought it under consideration in consequence of the publication in the "Edinburgh New Philosophical Journal," of an account by Mr. Thomas Stevenson, of a contrivance similar to one which he had laid before the Bombay Society in 1852, and which he had been in the habit of using ever since for determining the fact. Both Mr. Stevenson's instrument and his own, consisted of a piece of mirror, placed so as to reflect the clouds near the zenith. In Mr. Stevenson's contrivance the glass was ruled into compass points, and regulated by a needle; in the other it was simply divided into squares and placed in the meridian by compass. A very convenient addition was to have a second mirror placed over the first, so as to throw the reflection of the clouds in the direction of where the observer

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usually sat, and to furnish him at any time with the means of examining them. Mr. Stevenson's assumption that this instrument might be made a substitute for the common vane, or used for the purpose of predicting when the wind would change, seemed altogether unwarranted, though it might be valuable as an addition to our stock of Moteorological instruments. It seemed likely that in no case where two or more strata of clouds were visible at different elevations, would they be found to move in the same direction, when the intervals between them were considerable, and yet it by no means followed that the winds in the upper regions ever descended towards the surface. The most experienced Aeronauts had observed, that in the north of Europe the current of air was at the elevation of ten thousand feet invariably from some point betwixt North and West, whatever might be its direction at the surface. Nearly the whole of last year,—and the case might probably be the same every year were it observed—the upper clouds at Bombay during the north-west monsoon had drifted from south-west. It was the lower clouds only which followed the direction of the land and sea breezes, the drift even of these often continuing in the direction of the latter, which was the predominating wind, even when the former was blowing. In January 1853 the balloon set off from Byculla only followed the direction of the sea breeze to the altitude of 500 feet, when it ascended vertically for about a mile, and then pursued a path almost the opposite of that it had originally taken; and the conclusion then drawn was, that probably at all seasons of the year there was a strong upper current from the south-west, whatever might be the direction of the breeze on the surface. Dr. Buist then went on to explain the doctrine of vertical currents, now being universally accepted as throwing light upon these matters, expressing his regret that so little attention should be bestowed on this division of the subject by Meteorologists in India, who seemed to rest satisfied with following out the instructions sent to them from Europe. It was impossible for the philosophers who prepared these instructions, and whose experiences were confined to the cold and cloudy climate of the North of Europe, to know the points to which attention ought specially to be directed in those torrid regions which furnish the true field of Meteorological enquiry, and where observers on the spot must work out these matters for themselves. Were vessels proposing to make a voyage from Bombay to Kurrachee in December, observing the cloud drift from the south-westward, to wait according to Mr. Stevenson's views till the upper current descended to the surface, they must remain in harbour till the month of June, when they would probably find more wind than they wanted.

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The Ordinary Monthly Meeting of the Bombay Geographical Society was held on Thursday the 20th September,—Admiral Sir Henry Leeke, President, in the Chair.

PRESENT.

Lady Jackson; Lady and Miss Leeke; Mesdames Malet, Young, Leith, Jenkins, Hale, Haines, Spring, Edwards, Scovell; Misses Edwards; Sir C. Jackson; Hon'ble Mr. Malet; C. J. Erskine, Esq, C.S.; J. M. Erskine, Esq, C. S.; Col. LeG. Jacob; Brigadier Hale; Colonel Grant; Dr Don; Dr. Edwards; Rev. Dr. Wilson; Dr. Coles; Dr. Peet; H. L. Anderson, Esq. C. S.; H. Young, Esq., C. S.; Captain Russell; Captain MacGregor; F. Hutchinson, Esq.; W. F. Hunter, Esq; Rev. Messrs. P. Anderson, F. J. Spring, and T. G. Clark; Mr. Scovell; Mr. Clerk, I. N.; A. Robertson, Esq.; J. Robertson, Esq. C. S.; J. Stuart, Esq.; Professor Sinclair; Mr. Boswell; Mr. Peyton; Mr. Firth; Dr. Impey; J. F. Hutchinson, T. L. Jenkins, Wolterton, Cursetjee Jamsetjee, Juggonath Sunkersett, Venayekrow Juggonathjee, Narrayen Dinanathjee, Dhunjeebhoy Framjee, Govindjee Narrayen, Bhow Dajee, Narayen Dajee, Kaikesro Hormusjee, and Dosabhoy Framjee, Esquires.

The following Letters and Papers were laid on the Table:—

LETTERS.

From the Hon'ble the Colonial Secretary of Colombo.

From H. L. Anderson, Esquire, Secretary to Government.

From the Secretary to the Royal Geographical Society, London.

From Dhunjeebhoy Framjee, Esquire.

PRESENTS MADE TO THE LIBRARY BY GOVERNMENT.

1. Bombay Government Records, New Series, No. XV., containing Miscellaneous Information on the Province of Kutch.

2. Captain Wingate's Report on the Badamee and Bagulkote Talookas, Belgaum.

3. Do. Do. on Survey and Assessment for Rutnagherry.

4. Do. Do. Do. for Khandeish.

5. Do. Survey Report on certain Talookas in the Dharwar Collectorate, also Extract from Mr. C. J. Manson's Report on the History of Khickodee District, Belgaum.

6. Lieutenant Colonel Walker Scott's Report on the Management of Canals and Forests in Sinde.

7. Lieutenant Chapman's Report on proposed Canal and Railway in Sinde.

8. Reports by Lieutenants Webster, Lester, and Dickson on the Districts lately resumed from Meer Alli Morad, in Sinde.

9. Inam Commissioner's Report on a claim to the village of Modugay in Belgaum.

10. Mr. C. E. F. Tytler's Report on the Kownase Talooka, Nassick.

11. Lieutenant P. M. Melvill's Reports on portion of Ahmedabad Col-

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lectorate, also Captain J. Cruickshank's Report on the portions of the Duscroee Purgunna, Ahmedabad and Kaira Collectorates.

12. Captain J. Cruickshank's Report on certain Pergunnas in the Ahmedabad and Kaira Collectorates.

13. Lieutenant J. T. Jameson's Report on the District of Sahitee.

14. Mr. R. N. Goodine's Report on the Deccan Village Communities.

15. Deaths of Bombay during 1854, by Dr. Leith.

16. The Journal of the Indian Archipelago Vols. VIII. and IX.

17. A Grammar of the Huzvarash, or Proper Pelvi Language, by Dunjeebhoy Framjee, Esq. By the Author.

Mr. Scovell and Mr. A. Robertson were proposed for ballot at next Meeting.

The Secretary stated that as they had no business before them, the half hour usually devoted to this, might be occupied by the examination of some tank plants that had been brought for examination. The first was the Lotus or Sacred bean of India, now in magnificent flower in a tank in Mahim Wood, and in another at Bandora. The leaves produced were from a foot to a foot and a half in diameter, many of the flowers measured from six to eight inches across when expanded naturally, or upwards of a foot when the petals were stretched out. The peculiar position of the seed, the half of which exposed itself naked from the top of the inverted cone, forming the *stigma* in the flower, was particularly noticed. Four varieties of beautiful water lily, white, blue, blood red, and pink, all now in flower, were exhibited. The root of one of these was shewn in a glass jar throwing out fresh leaves. The root was covered by a fine brownish down, which, when narrowly examined, represented a cocoanut grove. The individual trees are about half an inch long and of the thickness of a horse hair; when a hand approached the jar they disappeared, being in fact beautiful microscopic worms; the ciliary movements around the mouth, the digestive processes, and circulation of the blood, being all visible under a moderate magnifier. On the table was a glass box or Aqua-Vivarium, filled with a beautiful little white flowering plant, called the *Meneanthes Indicus*, or Buck bean. This formed a pretty decoration for the drawing-room table, throwing out a succession of flowers for weeks if kept floating in water, in a jar or jelly glass. It was stated that this, together with all the lilies, would flower readily in ordinary tubs or large flower pots, and greatly exceeded in beauty the plants we were accustomed to.

LECTURES.—The first two Lectures on the Notice List, were "On the Steamer Tracks from Bombay to Aden, recently pursued by the packets during the South West Monsoon," and "On the bottle logs of the Arabian Sea"; Charts illustrative of both of these subjects were exhibited and explained, but the Lectures were postponed to give place to Colonel LeGrand Jacob.—*See Transactions* xiii. p. 149.

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A numerous and influential audience assembled in the Town Hall on the afternoon of Friday, the 12th October, to listen to the interesting lecture of Colonel LeGrand Jacob on his very recent travels in the Archipelago, Australia, New Zealand, and Tasmania. Among the ladies and gentlemen present we observed the Right Hon'ble the Governor, in the chair; Miss Leeke; Mrs. Peet; Miss Willoughby; Miss Spencer; Mrs. and Miss Hough; Admiral Sir Henry Leeke; Dr. Buist; Major Woosnam; Colonels Jacob, Willoughby, Lyon, Grant, Bates; Drs. Don, Peet, Craig, Impey; Captains Barr, Russell, Mylne, Elphinstone, Elliott; Reverend W. K. Fletcher; Reverend W. W. Peyton; Professors Fraser and Sinclair; Captain Selby; Brigadier Parr; Messrs. W. P. Adam, Cursetjee Jamsetjee, J. H. Standen, Sorabjee Jamsetjee, C. Leggat, Burgoyne, W. H. S. Crawford, Dunjeebhoy Framjee, Narayen Dinnanathjee, Dosabhoy Framjee, N. Spencer, A. Johnstone, C. and W. Swanseger, F. Hutchinson, C. Durham, J. Stuart, Bomanjee Pestonjee, Ardashir Framjee, &c. &c.

The following gentlemen proposed at last meeting were duly elected:—

J. M. Erskine, Esq., C. S., Captain Hamilton, I. N., Munguldass Nathoobhoy, Esq., W. C. Sillar, Esq., W. T. Roper, Esq.

The following gentlemen were proposed for election at next meeting:—

Sorabjee Jamsetjee, Esq., proposed by Admiral Sir H. Leeke, seconded by Colonel LeGrand Jacob.

C. Leggatt, Esq., proposed by Dr. Buist, seconded by Dr. Impey.

Dr. A. Thomson, 43rd Ben. N. I., proposed by Dr. Buist, seconded by Professor Sinclair.

After the disposal of the ordinary business of the Society Col. Jacob gave a continuation of his former lecture on Borneo &c.

The Ordinary Monthly Meeting of the Bombay Geographical Society took place on Thursday the 17th January, 1856, William Frere, Esq., Sudder Adawlut, in the Chair. A large collection of Maury's Wind and Current Charts, mounted and arranged, was exhibited, and it was pointed out that, though the British Government had the same results in view, the method desired to be pursued for their attainment, was likely to differ materially from that of the Washington Astronomer. The Secretary then gave the following short outline of the Physical Geography of India, taking his illustrations from the Geological Map of Mr. Greenough, and a large collection of Colored Physical Maps, prepared to illustrate a work on the subject. It was explained that a Lecture Map ten feet by twenty, constructed by the Messrs. Johnston of Edinburgh, together with several hundred square feet of drawings, had been lost on board the *St. Abbs*:—

"General Description.—Our recent conquest have extended our north-west frontier to almost everywhere beyond the Indus, and the British do-

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minions now stretch from the sea to the mountains, all around from Soonmayanee in Scinde to Arracan in Burmah; and the region to which the following remarks pertain is the same in its physical as its political boundaries and area. It forms a vast irregular lozenge, composed of two triangles, one of them nearly equilateral, resting on opposite sides of the 22d parallel. The peninsula of Hindustan proper—of about 1200 miles each side, extending from the latitude of Cutch and Calcutta, and so southward to Ceylon, in latitude 70—constitutes the southernmost of these and is bounded to the south-east and south-west by the Bay of Bengal and the Arabian Sea; the other, which rests on this, base to base, is obtuseangled and scalene, its apex reaching north beyond Attock, and its base extending along the shores of Scinde to Cape Manze, and those of the Bay of Bengal to the mountains eastward of Chittagong, or from the 67th to the 90th eastern meridian. It comprises an area of 1,309,200 square miles surrounded by a boundary of 11,260, or one-half the circuit of the globe. Of these square miles 800,788 belong to England, 508,412 to native states.

The features of this vast country are almost endlessly diversified. A huge range of mountain walls it in on the north-west, with a general equatorial direction, bending at the extremities south-east and south-west. A magnificent chain, constituting the Western Ghauts, runs nearly parallel to the shore, along the whole western sea-board, from Goozerat south to Ceylon. A large equatorial mass, forming the Vindhya range on the north and Satpooda on the south, bending eastward from this, constitutes the basin of the Taptee and Nerbudda. The Goomsoor and Rajmahal hills which bound the delta of the Ganges on the west, constitute almost independent masses; and the range along the eastern side of the peninsula towards the seaboard is, as compared to the Western Ghauts, irregular in structure and inconsiderable in elevation. Shelving or sloping gently from the inner sides of the latter of these, is the vast table-land of the Deccan, resting on the highlands of Malwa on the north, under the 20th parallel, and extending eastward and southward, till terminated by the mountain spur which stretches from the Nilgherries towards Madras. Stretching again from the base of the mountains on both sides of the peninsula into the shore, and so extending all round the sea-coast, is a low border on the eastern or Coromandel, and the Concan on the western or Malabar Coast. It varies from 5 to 50 miles in breadth, and its average elevation is about 30 feet above the level of the sea. A large portion of it is obviously of very recent marine origin; and on the northern and southern portion of the shores of Western India it is broken up into numberless islands, of which the group of fourteen—of which Bombay is one—is the best known and most beautiful.

It will be thus seen that the peninsula of Hindostan consists of three distinct parts—a central table-land, of an average elevation of about 1500 feet.

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and presenting on the west two stupendous groups, rising at Mahabaleshwar, near Bombay, under the 18th parallel, to the elevation of 4500 feet,—the Nilgherry group, under the 12th parallel, attaining an altitude of 8500 feet—and thirdly of the low land on the seaboard bewixt the foot of the hills and the shore.

Without at present taking into account the Soolimani and the Himalaya mountains, India, beyond the limits of the peninsula northwards, exhibits four grand divisions of surface,—1st. The great river deltas of the Indus and Ganges, consisting of almost pure alluvium, yearly adding to its mass, and which furnish by far the most fertile portions of the country; 2d. The Doabs, which may be described as the converse of the deltas—the latter being the rich lands which lie around the mouths, the former those which separate the branches of our principal rivers; both being to a greater or less extent subject to inundations, the Doabs being particularly accessible to artificial irrigation; 3rd. The Great Desert, which lies to the eastward of the Indus, and southward of the Sutlej, towards Delhi, and which long formed the defence of the British frontier; and lastly, The Terai, or gravel belt, which skirts the base of the mountains,—a tract of comparatively inconsiderable size, but so sigular in point of structure as to be deserving of a separate notice.

The Terai, or Tauri, is a large gravel belt, filling, to the depth of from 15 to 150 feet, a narrow, basin-shaped hollow, from 5 to 15 miles in breadth, and from 500 to 600 in length, skirting the base of the Himalayas. It is so penetrable to water, that rivers, after traversing it for a short distance, sink down and disappear under its surface, re-appearing again when a fault, dyke, or other obstruction, is met with, once more to disappear when this is passed. The marshes thus formed are so malarious, that the husbandmen by whom portions of the Terai are tilled hasten away from it as evening approaches, and make their abode high up amongst the hills. The insalubrious character of this singular region, at certain seasons of the year, pervades the vast Saul forests which skirt its margin all along; they are waterless, rivers sinking beneath them, and emerging in the Terai; and Nepaul is girt around by a border at times so dangerous to human life that for months together no one attempts to traverse it.

River Systems of India.—In India we have two stupendous river systems—the Himalayan and Hindustanee—drawing their supplies from totally separate sources, and traversing or surrounding the whole of the districts subject to the visitation of famine. The Indus, with its five magnificent tributaries which intersect the Punjaub, and the Ganges and Brahmapootra, with their gigantic branches derive their principal supplies from the melting of the snows; and the more fiercely the sun shines on the hills and the more insufferable that are the heats below, the more plentifully do these gelid storehouses give up their treasures. The whole of the Hindostan system of rivers, again, consisting of the Sabermutti, the Mahee, the Nerbudda, the Taptee, all discharging themselves into the Gulf of Cambay, in Western India; the

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Godavery, the Krishna, and the Cauvery, falling into the Bay of Bengal, originate in the western mountains, and are fed by the rains which fall over these, to the extent of 100 inches on an average, during the months of June, July and August. Both systems, whether fed by snow or rain, are in flood at the same period of the year, that being just the season when moisture is most required. Both draw their supplies from mountains too rocky or barren to require moisture, and too steep to retain it, and which send to the ocean, through tracts of the finest country in the world, supplies of water sufficient to transform them into one universal garden.

The following table is given by Hamilton of the probable length of some of the rivers of India:

		Miles to the sea.
1.	Indus,	1700
2.	Jamna (to its junction with the Ganges 780 miles),	1500
3.	Satlej (to the Indus 900),	1400
4.	Jhelum (ditto, 750)	1250
5.	Gandak (to the Ganges, 450)	980
6.	Godavery,	850
7.	Krishna,	700
8.	Nerbudda,	700
9.	Mahánadí,	550
10.	Táptí	460
11.	Cavery,	460

Remarkable Cataracts.—Girsappa, Western Ghats, top of fall to surface of basin, 828 feet, depth of basin, 300—total, 1188; from 300 to 600 feet across during the rains. Yena, Mahableshwar, 600 feet. Cavery, Mysore, 300 feet. Bouti, in Bandelkhand, 400 feet. Katra, in Bandelkhand, 398 feet. Chai, in Bundelcund, 362 feet. Keuti, in Bundelcund, 272 feet. Gokák, near Belgaum, 150 feet, 70 feet across.

When we find India generally talked of as one country of moderate extent, and nearly uniform condition and characteristics, it is not wonderful that the phenomena of the atmosphere should be spoken of with as much looseness as the geography of the land. The climate of India is in reality still more various and diversified than the features of the country. In the south, showers are frequent all the year round; on the southern Coromandel Coast three months of violent rain occur in winter, the rest of the season being dry; while a few degrees to the north of this on both sides of the Bay of Bengal, and all over Western India the precise converse of this is the case. In Central India the rain becomes extremely light, and occurs mostly about midsummer; in the north there are both the summer and winter rains; in Sindh and Beluchistan there is no rainy season whatever, and the heavy showers which occur irregularly, and at intervals of years are productive of sickness, and are considered injurious to the country.

From the conjoined influences of the heat of the sun and the rota-

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trade-winds, the two being separated from each other by a belt of turbulent and irregular currents, and frequent precipitation, called, the "Rains," calms or variables. These three great bands of air move somewhat to the north and south, according as the sun is to the northward or southward of the line; and where they impinge upon a continent or peninsula stretching towards the equator, a branch is broken off, and a current, varying according to the season of the year, produced, called monsoon. On the western side of India, north to the Gulf of Cutch, and on the western shore of Burmah and the peninsula of Malacca, this blows, for betwixt two and five months in summer, according to the latitude, from south-west; for the greater part of the rest of the year from north-west, and interval of storms and calms occurring in both cases at the period of change. It is usually held that this takes place about a week or ten days after the passage of the sun northward or southward over the parallel of the place, and that the rains which always accompany it follow and retire a few days afterwards. On the eastern side of the peninsula again, from Ceylon to considerably northward of Madras, lying in the lee as it were of the land, the monsoons blow from north-east and south-east, the former of which occurs in midwinter, being their rainy season.

Few things can be more striking than the state of the atmosphere or the aspect of the sky just as these periodical alterations are about to arise. From the beginning of November to the end of May the sky has been perfectly cloudless, and not a shower has fallen. Regular sea and land breezes setting in before noon and daybreak respectively, the former blowing from north-west for ten or twelve hours, the latter from due east for five or six, with intervals of calm between, have filled up the day and night. While this state of matters still continues, and not the slightest indication is given of coming changes, the stranger observes to his astonishment a sudden and simultaneous bustle amongst the whole community. The tents occupied by the troops, and the flimsy dwelling-places which had hitherto afforded accommodation to the European population, are suddenly pulled down and swept away, as if their occupants were fleeing before some fearful pestilence. The most substantial buildings, if thatched, have their roofs stripped off and renewed, and in any case have them thoroughly repaired, while all doors and windows facing the south-westward are boarded up, matted over, or in some way or other secured. Square-rigged vessels strike their upper mats, lower their yards, and make immediate provision for a storm, while as yet there is nothing whatever to warn the stranger of coming change; and the lighter native crafts are hauled up beyond the reach of the waves, and thatched over with a thick roofing palmyra leaves. Large clouds at length begin to make their appearance daily about noon over the western mountains, and advancing up the sky eastward, right in the teeth, as it would seem, of the wind then blowing, exhibit the most magnificent display first of sheet, afterwards of forked lightning. This goes on from day to day for about a week, the electrical displays becoming more vivid and intense every night. Until the rains actually fall, the clouds invariably disappear immediately after dark, and two hours

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after the sun has gone down surrounded by the emblems of coming tempest, the stars shine out everywhere down to the very edge of the horizon, and not a flock or film of vapour is to be seen staining the deep blue of the serene expanse from side to side of the firmament. Suddenly, and in general after a day of unusual tranquility, a little after sunset, a blast at once darts forth from the east, followed by a gush of rain as if the windows of heaven had been opened, the thunder roars and lightnings flash incessantly, the quivering light of a continuous succession of flashes being sometimes sufficient for five or ten seconds on end to permit the smallest print to be read. Sometimes it shoots upwards from the earth, sometimes it seems to rain down in long streams, like a string of red-hot beads, reaching from the clouds to the sea; most frequently it darts in long zig-zags horizontally from cloud to cloud, or bursting in all directions from a single point like a shower of coruscations shot on every side. This state of matters generally lasts from one to two hours, when the wind veers to round to south-westward, blowing with increased steadiness and diminished force, and the voice of the thunder, which had just before pealed in a succession of tremendous claps or roars, is heard lowly bellowing in the distance.

It may be mentioned in passing that although all our continued storms blew on us from the south-west, and the sea breezes during the fair weather are north-westerly, that our casual blasts invariably burst upon us from the mountains to the east of us, as if these formed the grand magazine of thunder and storm. The first burst of the monsoon seldom lasts more than a single night and part of a day, and the second dawn presents the most wonderful change in the scene than can be imagined. The burnt and parched earth seems now washed and refreshed everywhere, long spikes of grass of the tenderest green already shoot up from what a few days before were brown and barren plains; deep and filthy pits and unseemly tracts half choked up with rubbish, straw, and withered leaves, are now the basins of pellucid pools and lakes or the channels of magestic streams. The rays of the sun, no longer fierce and intolerable as they were a week before, shaded by intervening vapours or transient clouds, present that interminglement of alternating light and shade in the landscape which beautiful in itself, becomes doubly delightful from the contrast it exhibits to the uninterrupted and unceasing glare of the previous part of the year. After a few days' weather of this sort the rains return with redoubled violence, and continue to pour down for forty or fifty days, at an average of above an inch a-day, the ordinary fall in June, July, and August, amounting at Bombay to about 70 inches. Within a week or ten days of the commencement of the rains, so soon as the surface of the soil is fairly saturated, and occupied everywhere by rivulets or pools of standing water, the whole earth seems to swarm with fish. They are of four or five different varieties such as abound in the sea along-shore, and can live either in fresh or salt water. They vary in size from an inch in length to that of the forefinger, and are caught in myriads in baskets or in nets affording sport to the boys, and an agreeable article of food. Though their

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appearance has been mentioned by every one who has attempted to describe the rains for the last two centuries, it has never been so satisfactorily accounted for as could be desired. Colonel Underwood of the Madras Engineers, mentions a case where he was overtaken by a furious shower in the midst of the dry season, when the earth was at once covered with fish, which must have fallen from the heavens. But this scarcely seems to account for those which appear some ten days after the burst of the monsoon. Equally remarkable with this, though without its mystery, is the appearance of myriads of frogs of the most enormous dimensions, which occurs at the opening of the rains. At night their croakings fill the air whenever a shower falls; and they are seen in hundreds by the margins, or in the waters of every pool—at times resting on the lotus leaf, at times hurrying from the pursuit of the water-snakes which hunt and devour them. They are of a bright greenish yellow, and measure from six to seven inches from snout to vent, often bounding from six to nine feet at a spring. The rains slacken off early in August, and after the first full moon an offering is made, and a festival held by the natives to propitiate the ocean god, and vessels laid up in the end of May prepare for sea. After some weeks of open weather the Malabar Coast is usually visited in the end of September or beginning of October by a furious burst of thunder, rain, and easterly wind called the Elephanta, from its occurring as the sun enters the constellation of the Elephant, this finally closing the rainy season.

On the Bengal side the rains are about a week later in setting in than at Bombay. The amount of fall at Calcutta is nearly the same, but seems more violent while it lasts, and is somewhat less continuous. Along the whole of Eastern and part of Central India, the rains are preceded by furious whirling squalls, called north-western, from their coming down from the direction of the Himalayas, as our eastern squalls do from the Ghats; three or four of these occur during the months of April and May, and are frequently accompanied by furious hail-storms, the hail being on an average about the size of walnuts, frequently that of duck's eggs; single hailstones have occasionally been found from one to three pounds in weight. There are, indeed, four cases on record within the last 70 years of masses of ice having fallen from the firmament of from half a ton to a ton and a half in weight. Recent observations have shewn that the maximum fall of rain occurs, as might be expected, at the ordinary altitude of the principal layers of rain cloud, between 3000 and 5000 feet above the level of the sea, and the amount of fall regularly decreases above this as the higher regions of air are attained. The discharge where this sea of vapour impinges on a cold mass of mountains is tremendous. At Mahabaleshwar it amounts to betwixt 200 and 300 inches, it exceeds 200 on the same level at the Nilgiris, and at Cherapunj in the Kashia Hills northwest of Calcutta there is an average fall of no less than 610 inches, above 20 feet occasionally falling in the month of June.

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mountain walls, against which the clouds borne up from the sea first dash and discharge themselves, are comparatively dry, and the suddenness with which the transition takes place is often most remarkable. At Panchghani, 500 feet lower down, and ten miles farther east than Mahabaleshwar where from 250 to 300 inches fall, they have seldom more than 20 inches, while the average of the tableland of the Dakhan scarcely exceeds 25. When the rain clouds approach the arid plains of Sindh and Cutch, they appear to ascend and become absorbed by the air, passing on to precipitate themselves on the mountains the northward. There is much reason to believe that the fall of rain is diminished by the absence or destruction of trees. Were vegetation, sufficiently fostered in Sindh by means of irrigation, it might cause it to have its regular rainy season like the lands around.

Two events strike with surprise the ornithologist on the approach of the monsoon. Nearly all the kites, hawks, vultures, and carrion birds disappear from the sea-coast, while the crows begin to build their nests and hatch their young just at the season that seems most unsuitable for incubation, when the eggs are often shaken out, or the nests themselves are destroyed by the storm, and the poor birds are exposed in the performance of their paternal duties to all the violence and inclemency of rain and tempest. At the instigation of a sure and unerring instinct, the carnivorous birds, as the rains approach, withdraw themselves from a climate unsuitable to the habits of their young, betaking themselves to the comparatively dry air of the Deccan, where they nestle and bring forth in comfort, and find food and shelter for their little ones. The earth, once saturated with rain in the low country, abounds in grubs, snails, and worms, the food of the young crows, which the parent pick up in the soft and moistened soil, the rising generation coming forth just as the means of supplying them with suitable sustenance become plentiful. The scenes connected with this, which follow the conclusion of the rains, are curious enough. While the Muhommedans bury, and the Hindus burn, the Parsis expose their dead in large cylindrical roofless structures called Towers of Silence, where birds of prey at all times find an abundant repast. Their family cares and anxieties for the season, over the carrion birds, which had left in May for the Dakhan, return in October to Bombay, and make at once for the usual scene of their festivities, now stored with a three months' supply of untasted food. As they appear in clouds approaching from the mainland, the crows, unwilling that their dominions should be invaded, hasten in flocks to meet them, and a battle ensues in the air, loud, fierce, and noisy; the flapping of the wings, the screaming and cawing of the combatants resounding over the island, till the large birds succeed, and having gained the victory, are suffered thenceforth to live in peace.

It is just after the rains have well set in, that those beautiful exhibitions of thousands of fireflies flashing out in concert become visible. These brilliant little insects are generally seen dancing alone amongst shrubs and underwood, occasionally congregating in vast multitudes around isolated trees, which they at times render wholly luminous. At times the whole countless host flash

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out for a few seconds, and simultaneously at intervals of similar amount, becoming dark again, and so they flash and flash for hours on end. Sometimes they shoot in long columns into the air, like the coruscations of fire-works, becoming bright and dark by turns, or having reached a considerable altitude they seem to pour down in a shower of sparks.

Principal Falls of Rain in India—Eastern India and Bay of Bengal.

	Height.	Lat.	Long.	Fall of Rain.
Cherapunj	4500	25° 16	91° 43'	610 in.
Sylhet	5000	24 40	92 40	209 ,,
Tavoy	sea level	14 5	98 10	208 ,,
Moulmein	sea level	16 30	97 37	175 ,,
Sandowy	..	18 26	94 18	178 ,,
Akyab	sea level	20 8	92 54	155 ,,
Darjiling	7000	27 3	88 18	125 ,,

Shores of Western India.

	Height.	Lat.	Long.	Fall of Rain.
Mahabaleshwar	4500	17° 43'	74° 35'	248 in
Attagiri	2200	11 25	..	170 ,,
Khandalla	1740	18 30	74 30	168 ,,
Atrimallay	6000	11 30	76 20	164 ,,
Dhapuli	900	18 33	74 2	138 ,,
Angara Kandy,	Malabar Coast.	9	76 30	124 ,,
Cannanore	Ditto.	12	75 20	121 ,,

Average fall of Rain—At Bombay for 30, and Calcutta and Madras for 8 years, near the level of the sea :—

	Madras.	Bombay.	Calcutta.
January	3.50	.0	0.71
February	2.00	.0	0.55
March	0.25	.0	1.10
April	0.22	.0	2.95
May	5.00	·0	4.59
June	1.80	22.13	12.74
July	2.80	24.88	13.15
August	3.30	16.77	16.82
September	5.50	11.05	7.83
October	9.40	1.25	4.83
November	10.30	.0	.82
December	8.20	.0*	.50
Total	52.27	76.08	66.59

Remarkable Falls of Rain in India.—At Mahabaleshwar, in 1834, 302 inches fell in one hundred days; on the 4th of October 1846, 10 inches fell

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at Chittledrug in twenty-four hours; at Bombay, in 1825, 16 inches, and in 1844, 75 inches fell in twenty-four hours, 2 inches fell in seventy minutes; on the 1st July 9.43 inches, on the 10th, and on the 26th July 1840, 12 inches.—Sykes, Phil. Trans. 1850; Rep. Brit. As., 1849.

At Rajkot, on the 26th and 26th July 1850, 26 inches fell in twenty four hours, and 35 inches in 36 hours; 7 inches fell in one hour and a half at Ahmed?

With this general review of the principal physical features and climate of India, we may next pass to some of the leading peculiarities of the ocean which surrounds it.

'It is more than probable that besides the currents occasioned by the trade-winds, monsoons, and sets of the tides—we have a group of movements intermingled with these', dependent mainly on evaporation. When it is remembered that on the western shore of the Arabian Sea, including in this the Red Sea and Persian Gulf, from the line northward, we have an expanse of coast of no less than 6000 miles, and a stretch of country of probably not less than 100 miles inland from this, where the average fall of rain does not amount to four inches annually, where not one-half this ever reaches the sea, and where, to the best of our knowledge, the evaporation over the ocean averages at least a quarter of an inch daily all the year round, or close on eight feet annually, some idea of the enormous abstraction of water in the shape of vapour may be formed. On the assumption that this extends no further, on an average, than 50 miles out to sea, we shall have no less than 39 cubic miles of water raised annually in vapour from the northern and north western side of the basin, which must be supplied from the open ocean to the south, or the rains on the east. The fall of rain on the western side of the ridge of the mountain chain from Cape Comorin to Cutch averages pretty nearly 180 inches annually, and of this at least 160 is carried off to the sea: that on the Konkan to 70 inches, of which probably 30 flow off to the ocean or betwixt the two over an area of twenty miles from the sea-shore to the Ghats, and about 1200 miles from north to south, or an area of 24,000 square miles in all, we shall probably have an average discharge of nine feet, or close on forty cubic miles of water,—an amount sufficient, were it not diffused, to raise the sea on our shores three feet high over an area of 72,000 square miles.

The waters of the ocean cover nearly three fourths of the surface of the globe; and of the thirty-eight millions of miles of dry land in existence, twenty eight millions belong to the northern hemisphere. † The mean depth of the ocean is somewhere about four miles—the greatest depth the sounding line till of late has ever reached is five and a quarter miles. The mean elevation of the land again is about one thousand feet—the highest point known

† Since the above was written, Lieutenant Walsh, of the United States Navy, has sounded

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to us is nearly as much above the level of the sea, as the greatest depth that has been measured is below it. The atmosphere again surrounds the earth like a vast envelope, its depth, by reason of the tenuity attained by it as the superincumbent pressure is withdrawn, is unknown to us, but is guessed at somewhere betwixt fifty and five hundred miles, its weight and its constituent elements have been determined with the utmost accuracy. The weight of the mass is to equal that of a solid globe of lead sixty miles in diameter. Its principal elements or oxygen and nitrogen gases, with a vast quantity of water suspended in these in the shape of vapour; and communicating with these a quantity of carbon, in the form of fixed air, equal to restore from its mass manifold, the coal that now exists in the world. In common with all substances, the ocean and the air are increased in bulk, and consequently diminished weight by heat; like all fluids, they are mobile—tending to extend themselves equally in all directions, and to fiill np depressions in whatever vacant spaces will admit them; hence, in these respects, the resemblance betwixt their movements. Water is not compressible or elastic, and it may be solidified into ice, or vapourized into steam; air is elastic, it may be condensed to any extent by compression, or expanded to an indefinite degree of tenuity by pressure being removed from it—it is not liable to undergo any change in its constitution beyond these, by any of the ordinary influences by which it is affected. These facts are few and simple enough—let us see what results arise from them. As the constant exposure of the equatorial regions of the earth to the sun must necessarily here engender vast amount of heat,—and as his absence from the polar regions must in like manner promote an infinite accumulation of cold,—to fit the entire earth for a habitation to similar races of beings, a constant interchange and communion betwixt the heat of the one and cold of the other must be carried on. The ease and simplicity with which this is effected, surpass all description. The air heated near the equator by the everpowering influence of the sun, is expanded and lightened: it ascends into upper space leaving a partial vacuum at the surface to be supplied from the regions adjoining. Two currents from the poles towards the equator are thus established at the surface, while the sublimated air, diffusing itself by its mobility, flows in the upper regions of space from the equator towards the poles. Two vast whirlpools are thus established, constantly carrying away the heat from the torrid towards the icy regions, and these becoming cold by contact with the ice carry back their gelid freight to refresh the torrid zone. Did the earth, as was long believed, stand still while the sun circled round it, we should have two sets of meridianal currents blowing at the surface of the earth directly from north and south towards the equator, in the upper regions flowing back again to the place whence they came. On the other hand were the heating and cooling influences just referred to to cease, and the earth to fail in impressing its own motion on the atmosphere, we should have a furious hurricane rushing round the globe at the rate of 1000 miles an hour—tornadoes of ten times the speed of the most violent now known to us, sweeping everything before them. A combination of the two

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influences, modified by the friction of the earth, which tends to draw the air after it, gives us the Trade-Winds—which sweep round the equatorial region of the globe unceasingly at the speed of from ten to twenty miles an hour: the aerial current, quitting the polar regions with the comparatively tardy speed from east to west imposed on it by the velocity due to the 70th parallel, is left behind the globe, and deflected into an oblique current as it advances southward, till, meeting the current from the opposite pole near the equator, the two combine and form the vast stream known as the Trades,—separated in two where the air ascends by the belt of variable winds and rains. Impressed with the motion of the air constantly sweeping its surface in one direction, and obeying the same laws of motion the great sea itself would be excited into currents similar to those of the air were it not walled in by continents and subjected to other control. As it is, there are constant currents flowing from the torrid towards the frigid zone, to supply the vast mass of vapour there drained off; while other whirlpools and currents, such as the gigantic Gulf Stream, come to perform their part in the same gigantic drama. The current just named sweeps from the Cape of Good Hope across the South Atlantic to the Gulf of Mexico, and by the Straits of the Bahamas. Here it turns to the eastward again, travelling along the coast of America at the rate of from forty to a hundred miles a day: it now stands once more across the Atlantic, and divides itself into two branches—one finds its way into the Northern Sea, warming the adjoining waters as it advances, and turning back, most likely to form a second great whirlpool rejoining the original stream near Newfoundland. The main branch seeks the northern shores of Europe, and, sweeping along the coast of Spain and Portugal, travels southward by the Azores to rejoin the main whirlpool. The waters of this vast ocean river are to the north of the tropic greatly warmer than those around: the climate of every country it approaches is improved by it, and the Laplander is enabled by its means to live, and cultivate his barley in a latitude which everywhere else, throughout the world is condemned to perpetual sterility. But there are other laws which the great sea obeys, which peculiarly adapt it as the vehicle of interchange of heat and cold betwixt those regions where either exists in excess. Water, which contracts regularly from the boiling point downwards, at a temperature of 40° has reached its maximum of density, and thence begins to grow lighter. But for this beneficent provision, the various recesses of the frozen ocean would be continually occupied with a fluid, at the freezing point, which the least access of cold would convert into one solid mass of ice. The non-conducting power of water, which at present acts so valuable a part in the general economy, so far from being a blessing would be a curse. No warmth could ever penetrate to thaw the foundations of the frozen mass—no water find its way to float it from its foundations, so that, like the everlasting hills themselves, rooted immoveably in its place, every year adding to its volume, the solid structure would continually advance to the south-ward, hermetically sealing the Polar Ocean, thus condemned to utter desolation, and encroaching on the North Sea itself. Under existing

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circumstances, so soon as water is cooled down to 40° it sinks to the bottom, and, still eight degrees warmer than ice, it attacks the bases and saps the foundations of the icebergs—themselves gigantic glaciers which have fallen from the mountains, into the sea, or which have grown to their present size in the shelter of bays and estuaries, and by accumulations from above. Once forced from their anchorage, the first storm that arises drifts them to sea, where the beautiful law which renders ice lighter than the warmest water enables it to swim, and floats southward a vast magazine of cold to cool the tepid fluid which bears it along—the evaporation at the equator causing a deficit, the melting and accumulation of the ice in the frigid zone giving rise to an excess of accumulation, which tends along with the action of the air and other causes, to institute and maintain the transporting current. These stupendous masses, which have been seen at sea in the form of church spires and Gothic towers and minarets, rising to the height of from 300 to 600 feet, and extending over an area of not less than six square miles, the mass above water being only one-tenth of the whole, are often to be found far within the tropics. A striking fact dependent on this general law, has just been brought to light; there is a line extending from pole to pole at or under the surface of the ocean, where an invariable temperature of 39° .5 is maintained. The depth of this varies with the latitude; at the equator it is 7200 feet—at lat. 56° it ascends to the surface, the temperature of the sea being here uniform throughout. North and south of this the cold water is uppermost, and at lat. 70° the line of uniform temperature descends to 4500. But these, though amongst the most regular and magnificent, are but a small number of the contrivances by which the vast and beneficent ends of Nature are brought about. Ascent from the surface of the earth produces the same change in point of the climate as an approach to the poles; even under the torrid zone, mountains reach the line of perpetual congelation at nearly a third less altitude than the extreme elevation which they sometimes attain: at the poles, snow is perpetual at the ground, and at the different intervening latitudes reaches some intermediate point of congelation betwixt 1000 and 20,000 feet. In America, from the line south to the tropics, as also in Africa, within similar latitudes, vast ridges of mountains covered with perpetual snow, run northward and southward in the direction of the meridian right across the path of the Trade-Winds. A similar ridge, though of less magnificent dimensions, traverses the peninsula of Hindustan, increasing in altitude as it approaches the line,—attaining an elevation of 8500 feet at Dodabetta and above 6000 in Ceylon. The Alps in Europe and the gigantic chain of the Himalayas in Asia, both far south in the temperate zone, stretch from east to west and intercept the aerial current from the north. Others of lesser note, in the equatorial or meridianal, or some intermediate direction, cross the paths of the atmospherical currents in every direction, imparting to them fresh supplies of cold, as they themselves obtain from them warmth in exchange; in strictness, the two operations are the same. Magnificent and stupendous as are the effects and re-

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the temperature of the globe, they are still more so when combined. One cubic inch of water when imbued with a sufficiency of heat will form one cubic foot of steam—the water, before its evaporation, and the vapour which it forms being exactly of the same temperature, though in reality, in the process of conversion 1700 degrees of caloric have been absorbed or carried away from the vicinage and rendered latent or imperceptible; this heat is returned in a sensible and perceptible form the moment the vapour is converted once more into water. The general fact is the same in the case of vapour carried off by dry air at any temperature that may be imagined (for down far below the freezing point evaporation proceeds uninterruptedly), or raised into steam by artificial means. The air, heated and dried as it sweeps over the arid surface of the soil, drinks up by day myriads of tons of moisture from the sea—as much indeed as would, were no moisture restored to it, depress its whole expanse at the rate of four feet annually over the surface of the globe. The quantity of heat thus converted from a sensible or perceptible to an insensible or latent state, is almost incredible. The action equally goes on, and with the like results, over the surface of the earth, where there is moisture to be withdrawn, as over that of the sea. But night, and the seasons of the year, come round, and the surplus temperature thus withdrawn and stored away at the time it might have proved superfluous or inconvenient, is reserved and rendered back so soon as it is required; and the cold of night, and rigor of winter, are modified by the heat given out at the point of condensation, by dew, rain, hail, and snow.

The settings in of our Monsoons present us with phenomena of such singular harmony and beauty, and they depend on the application of so many simple and thoroughly intelligible principles, as to furnish us with some of the most magnificent poetry of Nature. The explanation of nearly all the phenomena is perfectly simple, and has long been thoroughly understood by men of science. They can be watched only by the European during his short sojourn in India, and seen only to perfection by the sea-shore, and as it is to be feared that a considerable majority of those, who may regret afterwards not having made better use of their ears and eyes, view the approach of the rains with pretty nearly the same amount of intelligence and inquisitiveness as the natives themselves, I shall make no apology for endeavoring to give a short explanation of the causes and leading phenomena attendant on the monsoon, although aware that the bulk of these are perfectly understood. The term monsoon simply signifies season, although we speak here of the south-west monsoon almost by this name exclusively, that being the period of the year most abundant in striking phenomena. It must be remembered at the outset that all bodies, whether solid, liquid, or aeriform, the last most conspicuously of all, increase in bulk when heated, and so diminish in weight mass for mass. If for example a hundred cubic inches of air weighs, as it does pretty nearly, thirty one grains at the freezing point, a hundred cubic inches when

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enclosed in a bag of sufficient size rising through the heavy, a considerable load along with it. The simplest illustration of t in lighting a fire in an open grate, when feathers, scraps of pa light materials will rush towards the fire place and so up the the same thing will be seen on a smaller scale by approaching stance to the base of the funnel of an argand lamp. Let well remembered—simple and familiar as they are, they furn key to the whole phenomena of all our atmospheric mov being the open fire or argand lamp heating the air under him petual upper current, the place of which must be supplied b at the surface of the earth.

When such great Promontories as those of America, A and the Malayan peninsula intrude themselves into the r Winds, they interrupt their continuity and disturb their c which warms the sea to a temperature nearly uniform of ween the tropics often heats the land above a hundred. in fact of a gigantic pump, the air on the surface of the rushing towards that point on which his rays are conce middle of August to the middle of May accordingly, ther that vast sea of air which the mountains and table land c cooled, perpetually flowing past us towards the south, a north-west monsoon. Steadily as the sun crossing the l the northward, our winds become less northerly, and m erly, when from the middle of May to the middle of similar rush from the southward which constitutes our Nothing however can be more opposed to each othe of the two masses of air thus set in motion: that cold and dry from the expanse of arid desert which where it has thrown off all its superfluous moisture winter rain, or dew—that again from the south-w a surface of betwixt two and three thousand r reaches us, comes saturated and loaded with moisture precipitate on any body colder than itself. This is ill familiar to every one, that of the damp appearing on when a piece of ice is put into it, the surrounding air l point when it can no longer hold the moisture pr throwing it down on the surface by which it was cool law that must be kept in view to explain the phen correctly. A cubic foot of air weighing, as before s will hold in solution at 85 temperature, 12.35 grains o ter at 30 inches but the same cubic foot if expanded moved, so as to contain half this weight, will only d ture nearly. At Mahabaleshwar the Barometer v Bombay, sinks to 26, on the Nilgiris to 22, and t Himalayas till they saw the mercury at 14 inches,

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mosphere would contain less than half the quantity of actual gaseous matter which it did at the surface of the ground, holding a proportionably diminished quantity of moisture in solution. Along our shores it is found that the air during the south-west monsoon approaches nearest the point of saturation at about three quarters of a mile, that is from two to four thousand feet above the level of the sea, and that here a vast sheet of atmosphere, probably a thousand feet in the thickness, prevails ready to discharge its treasures the moment it comes in contact with any thing colder than itself, or is forced upwards by an obstructing ridge of mountains so as to diminish its capacity for moisture. If these facts have been clearly stated, and are distinctly remembered and understood, the whole phenomena of our rainy season will dawn upon the reader at once. The wet south-west wind is at once obstructed by the ghats—which near their summits are colder than the air striking against them—this they at once cool and drive upwards, producing the double result of cooling and rarifying, both tending to precipitation when a huge gush of rain is the immediate result. As the season advances so does the cooling process which reaches its maximum about the month of July, when we have our heaviest falls. On this side of India Mahabaleshwar reaches the point of greatest precipitation, nearly thirty feet of rain being frequently measured—above this, as the experiments on the Nilgiris shew us, it diminishes to less than a fourth part of this—and as the air sweeps over the Dakhan, it is found in great measure deprived of its moisture, and at Puna scarcely a tenth falls of that measured at Malcolm Peth. But the most beautiful illustration of our doctrines, is that furnished by our travelling northward. At Surat the great ridge of the ghats begins to retire eastward; by the time we reach Broach it has receded seventy miles from the sea, and from the Gulf of Cambay to the mouth of the Persian Gulf, we have scarcely any thing deserving the name of mountain land near the shore. The moist sea of air flowing from the south-west which had given us seven feet of rain at Bombay and thirty at Mahableshwar, finds nothing either to cool or obstruct it in Mekran or Sindh— it becomes damp and cloudy, but passes over the burning desert without reaching the point of precipitation, and accordingly no rain falls until it reaches the mountain ranges and vast table lands to the northward of the Indus, where it follows the same law as it had followed on the Malabar Coast. We shall not here enter on the electrical phenomena of the monsoons, or attempt to describe how magnificently the mountains and clouds, in opposite states of excitement, exchange their lightnings with each other, the same things occurring with the different banks of clouds themselves. For the sake of simplicity we have spoken as if these phenomena were confined to Western Hindustan, instead of being of general prevalence, and have purposely avoided all allusions to the complications and modifications attending them. or

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The Ordinary Monthly Meeting of the Bombay Geographical Society took place on Thursday evening the 17th April, 1856, Admiral Sir Henry Leeke, President in the Chair.

The minutes of last meeting being read, the following letters and donations were placed on the table :—

From Government forwarding a volume of miscellaneous information connected with the native states in the Pahlunpoor Districts. From Government forwarding Mateorological Reports from stations under the Madras Presidency. From Commander Hardy, R. N., forwarding a circular in reference to the Beaufort Testimonial. From Sir Robert Hamilton forwarding a table of heights and distances between Bombay and Agra, starting from Surat, the course of the projected railway.

From Government.—A geographical and statistical report of the district of Beerbhoom—Report of the Schlaginweits' Magnetic Survey in the Himalayas. On the Harbours and Ports of the Northern Circars.—Journal of the Indian Archipelago.

Mr. Kingcome and Capt. Mylne were elected members, and Mr. Kennelly was proposed to be bollotted for at next meeting.

Amongst the curiosities on the table was a beautiful collection of large and magnificently carved rock crystal vases, of sword hilts, and vases in pale greenish and yellowish jade, richly inlaid with gold and rubies, the property of Colonel Guthrie, of the Bengal Engineers.

In reference to six Skeleton Charts of the World, four sheets each, forming Maps of 36 by 48 inches, the Secretary explained that they originated in this way. Dr. Lyon Playfair had complained to him of the want of a good large Skeleton Chart of the World, and of which a few of the outlines of the chief matters in Physical Geography should be laid down, such as Isotherms and the like. The Messrs. Johnston of Edinburgh, always ready for any enterprize that had the promotion of Geographical knowledge in view, however financially unpromising, immediately took up the scheme on a hundred copies being subscribed for, and the production of the beautiful maps now before them was the result. These were sold for two shillings the sheet, or eight shillings for the map—it would probably cost six rupees properly put on canvas. It was intended to be colored geologically, meteorologically, ethnologically, or botanically, as might be deemed expedient ;—it was meant to embody the information of naturalists as collected, but was eminently suited for lecture or school-room purposes. By such means as these a first rate Geographical or Physical Atlas might be obtained. Scarcely any attempt but that laid before the Society some weeks ago had as yet been made, and the only Atlas we possess for educational purposes might reasonably be exhibited as a curiosity in its way.

The President in laying before the meeting subscription lists for the Beau-

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licacy in stating what he knew to be deserved. The promoters of the Testimonial at home had asked the Society to leave the subscription paper in their rooms, and perhaps their friends upstairs, whose rooms were more frequented, would not object to a similar privilege.

Dr. Buist said that the occasion was one on which it became matter of regret, that no part of the funds of the Society could be devoted to such purposes as the present—otherwise the claims on them by Sir Francis Beaufort were of the highest description. I need not enter, continued he, on the world-wide celebrity of the name of the Hydrographer to the Admiralty—or the commendations he has personally received every where, and from every one who has come in contact with him—otherwise I might speak of his urbanity, his uniform accessibility, the kindness of his attentions to every one interested in Geographical pursuits, and his anxiety to assist in the promotion of physical science in every department. In 1845 I had occasion to bring under his notice a scheme of concerted Tidal and Meteorogical Observations for the Eastern Seas, similar to that so soon afterwards instituted and carried out with such admirable perseverance and success by the Astronomer of Washington.—Our plans were examined in detail with the utmost care and minuteness, and so warmly approved of, that through the instrumentality of Admiral Beaufort, a grant of £350 was obtained from the Admiralty for the purchase of instruments. It was no fault of his that the work was not carried into effect as intended, and that the grant has never become available. Every thing was done by him that could be desired, and the sources of obstruction which afterwards proved too powerful, appeared in quarters where they were least to have been looked for. In 1850 Sir Francis Beaufort had been entrusted with the expenditure of £200 to purchase Globes, Atlases, and other things intended to constitute the elements of the Ross Testimonial, and laboured as diligently in the task as if his life had depended on its successful performance. Not content with this, he contributed to the testimonial a complete set of all the Maps and Charts pertaining to the East, prepared under the authority of H. M.'s Government, and up to the present time scarcely any thing has been published by the Admiralty of which this Society has not been presented with copies. This, conjoined with the contributions made by the Court of Directors and various Governments of India, has supplied us with a collection of Charts and Maps the like of which is no where to be met with, save in America, out of Europe. When I saw him two years ago, though then bending under the load of four score years, and on the point of devolving his duties on other and on younger hands, he was active and alert as ever he had been, and as much alive as ever to every thing pertaining to his profession. Lieutenant Maury was then in Europe, enlisting the sympathies of all connected with navigation in his plan, and endeavoring to organize that system of concerted observations we at Bombay are allowed to have been the earliest to endeavour to work out. Sir Francis Beaufort requested me to proceed to the convention at Brussells as representing the Hydrographers of the East, where I should join and co-operate with Admiral Beechy, the re-

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presentative of the British Government. Sir Francis Beaufort *riatim*, and with the most surpassing clearness of apprehensic of the American scheme, discussing each of them in turn, and admirable plan of his own, projected more than twenty years same general view, which the sluggishness of the Admiralty carried out, and of which his own modesty deterred him fr merit. To him, to his successor Captain Washington, and tc the same department, Captain Beecher, and to Admiral Be Hydrographic department of the Board of Trade, I am in hints as to the improvement of the sub-surface currer strument, as well as for the construction of the Skeleton At Seas published in June 1854, and now in use amongst us— to have been compelled to introduce my own name where graphy were alone intended to have been touched upon. shew that there was nothing so slight or minute as not tc have claims on the attention of the Hydrographic departn ralty under the gallant officer now retiring from it.

The President stated that he hoped what Dr. Buist h ported at length, as evincing the special claims of Admi respect of the Bombay community.

The Lecture of the evening was, on the numberless made by the recent excavations for water. It was stated published on this subject, and that it had been so Society, that it was not likely that much could be said as entirely new—every dry season it had formed when a considerable number of facts were added collected.

The Ordinary Monthly Meeting of the Bombay Ge the Monsoon vacation, took place on Thursday Juggonath Sunkersett, Esquire, in the Chair. The laid on the Table :—

PRESENTS.

From the Bombay Government—Barometrical Surgeon Balfour, of the Madras Army.

A Report upon Education in Sind.

Nos. IV. and VI. Vol. IX., of the Journal of t

Printed copy of Selection No. XXXI. from the new series, containing Report by the Inam Commi rinjams.

Abstracts from the Meteorological Observation Royal Engineers in the years 1853-54. By Lieut

Correspondence illustrative of the practice of regarding adoptions, and the circumstances unde succeed to property held from the state.

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Correspondence regarding the concealment by the hereditary officers and others of the Revenue records of the former Government, and the remedial measures in progress :—I. Correspondence exhibiting the nature and use of the Poona Duftur, &c.—II. A Selection of Papers explanatory of the origin of the Inam Commission, &c.

Various Meteorological returns, viz :—From Master Attendant at Cocanada for May 1856.—From Master Attendant at Cuddalore for May 1856.—From Bhooj for June 1856.—From Baroda for June 1856.—From Bhagdad for May 1856.—Observations at the Dharwar Jail Hospital for April, May, and June.

From the Director of P. Instruction—Papers relating to the examination held at the Elphinstone College, Bombay, in December 1855.—Papers relating to the examination at the Poona College in December 1855.

From the Geological Society at Vienna.—36 Nos. of a Geological work in German, some of the numbers full of fine plates.

From London.—Vol. XXV. of Journal of Royal Geographical Society—Vol. XVI., Part 2, of Journal of Royal Asiatic Society of Great Britain and Ireland.

A List of books printed for the Oriental Translation Fund.

From Norton Shaw, Esquire—a French Pamphlet giving a Biblio graphical Sketch of the Libraries of various Geographers.

Received from Government, to be laid on the table of the Geographical Society for the general information of the members, and to be returned when done with, three printed reports, by the Messrs Schlagentweit, engaged in the Magnetic Survey of India.

The donations from Vienna were admired for their great magnificence, and the Society had reason to congratulate itself on the occasion which had opened up this new channel of intercourse betwixt them and Germany.

The proceedings of the day consisted chiefly in discussions as to the accuracy of Barometric measurements, generally prized more highly than they deserved to be. It was often boasted, that altitudes taken by the Barometer and Theodolite corresponded with each other to a foot or two. The occurrence of this must be very rare : where it was to be met with, it was ascribable purely to accident. Two Barometers of exactly the same construction, placed side by side and read by the same party, would not be found to agree with each other for twenty four hours on end. The altitude of a mountain would come out differently every time it was measured by a Barometer. Major Shortrede points out that the Barometric altitude of Poona, as referred to as a Bombay standard, differed from each other at different hours of the day ; and the Gerrards had long ago given illustrations of the same thing in their observations amongst the Himalayas. The great difficulty experienced by travellers, was to obtain a reference Barometer sufficiently near to be of service to them ; the Barometric measurements obtained from Persia, Affghanistan, and other remote quarters, must be received with large allowances, as having no means to refer to a Barometer for comparison within hundreds or

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sometimes within thousands of miles. The Secretary stated, that in travelling some twenty months ago through Kattiawar and Guzerat, he frequently found his Barometer to stand higher than that of Bombay in the same day and hour, leading to the inference, that the level of the interior was lower than the sea shore. On one occasion, the Barometer fell so as to indicate a very rapid ascent, where to the eye the country appeared level —this was afterwards found to be ascribable to a storm at Kurrachee some couple of hundred miles away, which left the mercury at Bombay unaffected. All these errors were very small in amount when reckoned in feet; and the Barometer was in reality an invaluable instrument where the level or the theodolite could not be resorted to, as being near enough the truth for all ordinary purposes; only its indications were to be received with a certain measure of reservation, and the idea scouted of its being comparable with the instruments of the Geometer. In India, from the smallness and regularity of its range, it became doubly convenient, and to assist in supplying the difficulty as to references, sets of tables had been published of the point at which the mercury stood every month of the year and every hour of the day in reference to all the places where trustworthy observations had been made, with other tables of altitudes ascertained trigonometrically by the officers of the great survey. By these means Barometric altitudes might be taken with very considerable confidence through more than half the year, without any reference to the Barometer at all, if the observer was within less than a thousand miles of some of the points referred to, and discarded all observations made during atmospheric disturbances; and the state of matters must improve as facts become multiplied. It was remarked on Dr. Balfour's Barometric sections, which gave rise to these observations—the Bombay Government having requested the opinion of the Society as to their merits,—that they furnished a very valuable contribution to Physical Geography, for which the Meteorologist and Geologist must feel most grateful. The Society were not in a position to test their accuracy, but from the fame of Dr. Balfour, there could be no doubt that every precaution had been taken to render them correct.

It was ultimately agreed by the Society, that in replying to Government to this effect, it should be suggested that it would be of very great value that a set of similar sections be prepared for the western Presidency, taken from the altitudes given by the trigonometrical survey and the levellings on our railways, with any such additions as the Barometer might supply; and that these would form a valuable appendix to the collection of Geological papers preparing for publication under charge of Dr. Carter.

On laying the Meteorological Observations taken at the stations of the Royal Engineers, edited by Colonel James, Superintendent of Ordnance Surveys, before the meeting, it was stated that these went far to upset many of the doctrines in reference to the atmospheric pressure long considered by us established. There was no reason to question their perfect accuracy on the vast number of points to which they referred, which rendered them of the

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utmost value.—From these and other researches now in progress it was obvious, that old Meteorologists must now set about studying the laws of atmospheric pressure anew.—

Mr. Berkley mentioned that in the comencement of the Railway Survey, a large number of observations had been made by the Aneroid, which were supposed likely to supply them with tracings which were expected to assist the Surveyors in discovering the best line to be followed with the level, but it was given up as far too loose. He then laid before the meeting a long list of levellings, made from Bombay right across the country until united with the railway levellings taken from Calcutta northward. This furnished the elements of two sets of sections from the east and west of the Peninsula extending north to Agra.

The great value of Mr. Berkley's communication was acknowledged, and a hope expressed that the altitudes now given, or hereafter collected, might be added to those already published.

The Ordinary Monthly Meeting of the Geographical Society took place on Thursday, October 16, 1856, Captain Jenkins in the Chair. A letter was laid on the table from Major Barr, offering his services to make observations while with the Persian Gulf Expedition provided he was supplied with instruments. The Society ought to thank Major Barr for an offer valuable under any circumstances,—peculiarly so from the zeal and ability with which Major Barr performed whatever he undertook. As the Society were at present somewhat short of supplies of instruments, it was resolved that Government should be applied to, to provide those which were deficient, as the Medical Storekeeper is understood to have lately received a large stock from Europe. The Chairman then stated, that on leaving England a few months since, he had undertaken to draw the attention of the Society to the very important expedition at present in contemplation under Captain Burton, of the Bombay. Army, into the interior of Africa, departing from Zanzibar, and to solicit assistance and information such as might help to promote the objects of the expedition. It was stated that it did not quite appear in what way the services of the Bombay Society could be made available on the occasion, but they would endeavour to do every thing that could be desired of them. A paper was laid before the meeting, by Captain Kempthorne, on some ruins of much importance in the Persian Gulf. As this had not been received till after the issue of the notice lists, intimating papers on other subjects likely to occupy the time of the meeting, its reading was deferred. The writer was desired to be thanked for his contribution. There being no other business before the meeting, the first paper read was on the late discussions in reference to the rotation of the moon round her axis.

Discussions on the Axial Rotation of the Moon.

Dr. Buist said,—I should scarcely have troubled the Society with the discus-

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which I have nothing to say that is new, but that I happened some time ago to have made up a little machine to illustrate one of Mr. Simmons' positions where it appeared to me that the examples selected by him for the proof of his theory was one of the best he could have chosen for its refutation. The same remark appears to have been made at the British Association, in reference to the apparatus exhibited and examples adduced by him. It is not however mentioned what these were, and it is quite possible that what I am now about to exhibit may be something altogether different from the contrivance shewn at Cheltenham. Whether it be so or not, it will afford the meeting some illustrations of the development of certain varieties of double rotatory motion, which may interest them. Mr. Simmons does not question the truth of any of the doctrines of astronomy, but conceives the nomenclature, so far as the actual rotation of the moon is concerned, delusive and affirms that our satellite only revolves, and not otherwise in the same sense in which a peg in the tier of a wheel may be said to revolve on its axis, exhibiting as the moon does the same aspect always to its centre. The examples of this most familiar to us in these times, may be found in the crank of a steam engine—the crank pin may be supposed the moon, its centre of revolution the paddle shaft represents the earth, to which certainly it does always turn the same side, but it exhibits all its sides in turn to the spectator, and to the rod connecting it with the working beam or cylinder which drives it. That the crank is endowed with double rotation will be seen by any attempt to key it or stop it on its own axis, when it will instantly be arrested in its orbit—that is, the engine will stop or break. But this being granted, the similitude between the moon's motions and those of the crank pin still remains to be shewn. If a single impulse would give the moon both its motions, then Mr. Simmons might claim something in the way of support. But if I take a piece of stone, say a cube represented at figure II., and project it forward into space, it will go right on without any axial revolution, or rotation of any kind, until it falls upon the ground. Now the parabolic curve here described by the stone is exactly that which the moon describes, only I have not given it force sufficient to project it far enough, otherwise it would have fallen beyond the earth and gone round. All motion is naturally rectilineal, and bodies projected forward will hold on for ever in a straight line through space, until some other force be impressed upon them. The constraining force in both cases is that of gravitation, which draws both stone and moon towards the earth—the latter strikes for want of force, the former goes on under the joint influence received at first by it from the Creator, modified by gravitation and centrifugal force. Had it been the will of the Creator to project the moon into space by a single force, she might have circled for ever round the earth, presenting to us all her different sides in turn, without any axial rotation. Instead of this, two separate and distinct motions were impressed upon her —one impelling her round the earth, and one impelling her round her own

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fails. Mr. Simmons says, in a letter to the *Times*, that were we to stop the moon in her circuit round the earth, the moon would cease simultaneously with this to rotate round her axis. Although we cannot perform the experiment on a large scale, the end may equally be obtained through a model.

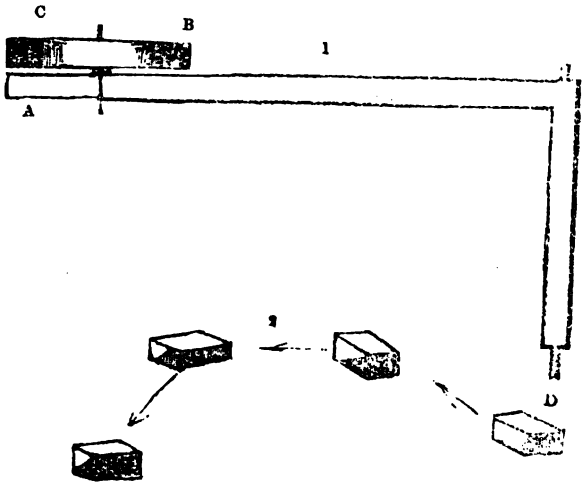

Figure I. represents an upright axis with an horizontal arm. The axis revolves freely in a socket and collar, permitting the arm to sweep rounds On the end of the axis is an iron wheel, in this case a foot in diameter—the dimensions and proportions are immaterial, the present has been assumed as matter of conveniency merely. The wheel is permitted to revolve freely on its axis, with as little friction as may be. When I start the arm suddenly forward in the direction of C A, the subsidiary wheel will be seen to revolve backwards in the direction of A C B. After two or three revolutions it will come to rest, revolving on the arm, but not apparently on its own axis. If I now suddenly stop the arm, still in a state of rapid motion, the iron wheel will keep flying round for some time in the direction of B C A, the reverse of that in which it at starting moved. This last meets the assertion of Mr. Simmons, who affirmed that when orbitual motion ceased, axial motion would cease also. The three movements admit of easy explanation. The whole mass of the wheel receives initiatory motion in the line of its own axis, and had this proceeded straight, the wheel would not have revolved at all. But the inner part of the wheel traverses in each circuit a less sweep than the centre, a less one still than that of the outer rim. The force required to put any body in motion is a joint function of the mass to be moved, and the speed at which it is to be so. It requires a greater force to move the rim at

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tion of its axis, but for this it would have revolved be
which carried it swept forwards. Having been brough
vious round motion through this cause, all parts of the
speed of the part of the arm nearest it, so that A is no
rapidly than B. When the arm is stopped suddenly,
at its former speed, the wheel now revolving in advar
more brings it to a state of rest. It will thus be seen
has no friction were arrested in the line of her centre,
ing for ever round her own axis, though standing
becomes plain that the motions of Mr. Simmons and
become confused on these subjects altogether, from
having seen meet to make the moon, through differe
perform her orbitual and axial motions at the same t
or a spot on the earth's surface, under totally differer
ed their orbitual and axial motions simultaneously
speaking, a geographical subject, but we are not ver
we assign to our discussions, and it has been long u
advantageously take up subjects of popular exciten
not Geographical, and though there was not very
it. I do not consider these remarks in any way
Transactions, though they are at the service of th
they be deemed worthy of a share in their space.-
the subject expressed his entire concurrence in th
he said had mainly confined himself to a discus
illustrations. The libration on the moon's axis,
by throwing up a ball with a pencil through it, a
parate class of motions which had no similitude
bited. Dr. Sinclair's illustration will be underst
where the axis of our satellite in librating while
of cones, with their apices to the centre. The
est and some duration, and was hailed as an ap
where the best part of the proceedings of learn
the debates which followed the reading of a pa

The next subject taken was the encroachm
around. As this consisted mainly of a collecti
time to time appeared in our pages, it does no

The Ordinary Monthly Meeting of the Bo
place on Thursday, December 16, 1856, Li
chair. The following donations were prese

Received since last meeting, from Gove
regarding the Ford Wah in the Shikarpo
From London, two books of the address a

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Royal Geographical Society, 26th May 1856; two books of the meeting of the members of the Royal Institution of Great Britain.—From Greenwhich, Magnetical and Meteorological Observations for 1856.

The following letters with reference to the African Expedition were laid before the Society.

From H. L. Anderson, Esq., Secretary to Government.

To George Buist, Esq., L.L.D.,
Secretary to the Bombay Geographical Society.

26th November 1856.

Sir,—I am directed by the Right Hon'ble the Governor in Council to request, that you will be so good as to express to the Geographical Society the wish of Government, to be favored with the loan of any Charts of Zanzibar, and the African Coast adjacent which may be on its records, for the use of Lieutenant R. F. Burton, who is proceeding in command of an Expedition to Equatorial Africa, under the patronage of Her Majesty's Government,—I have &c.

H. L. Anderson Secy. to Govt.

Bombay Castle, 26th Nov. 1856.

To H. L. Anderson, Esq., Secretary to Government.

Sir,—In reference to your letter, No. 5379 of 1856, dated 26th November, I have the honor to forward three Charts of the Coast of Zanzibar, by Captain Owen of the Royal Navy. These form part of the contribution of Her Majesty's Lords of the Admiralty to the Ross Testimonial, and can therefore only be lent. It seems probable at the same time, that copies of them may be found in the Draftsman's Office.

Captain Burton, for whose use they are intended, is no doubt already in possession of the information in reference to this part of Africa in the Church Missionary Society's publications, as also in the Transactions of the Royal Geographical Society of London, and the Bombay Geographical Society.

I have &c.

Bombay, 27th November 1856. George Buist, Sec. to the Society.

From H. L. Anderson, Esq., Secretary to Government.
To the Medical Board, Bombay.

17th December 1856.

Gentlemen,—I am directed by the Right Hon'ble the Governor in Council to acknowledge the receipt of your Secretary's letter, No. 3246, dated the 3rd instant, and to inform you, that Government approves of your recommendation therein contained with reference to the Medicines and Instruments

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to be supplied to Mr. Assistant Surgeon Steinhauser, in the event of its being finally decided that he is to proceed with the Expedition into Equatorial Africa, under the command of Lieutenant Burton, of which due intimation will be given you. I have &c.

(Signed) H. L. ANDERSON,
Secretary to Government.

Bombay Castle, 17th December 1856.

To G. BUIST, Esq. Secretary Geographical Society.

17th December 1856.

Sir,—I am directed by the Right Hon'ble the Governor in Council to acknowledge the receipt of your letter dated the 8th instant, relative to the Expedition into Equatorial Africa under the Command of Lieutenant R. F. Burton of the 18th Regiment, Bombay Native Infantry.

2. In reply, I am desired to request, that you will have the goodness to communicate to the Committee of the Bombay Geographical Society, the thanks of the Right Hon'ble the Governor in Council, for the valuable suggestions contained in your letter.

3. It being very desirable that Lieutenant Burton should be provided with proper instruments for determining the height of mountains, &c., advantage will be taken of the expected arrival in Bombay of the Messrs. Schlaginheweit on their way to Europe, to procure from them, if practicable, some of the instruments which they have had in use in the Himalayas, and to forward them by the first safe opportunity to Lieutenant Burton.

4. I am further desired to transmit, for the information of the Geographical Society, copy of a letter from the Acting Secretary to the Medical Board, No. 3246, dated the 3rd instant, and of my reply of this date.—I have &c.

Bombay Castle, 17th Dec. 1856. H. L. ANDERSON, Sec. to Govt.

From W. C. Coles, Esq., Act. Sec. Medical Board
To the Secretary to Government.

3rd December 1856.

Sir,—With reference to your letter, No. 5469, and adverting to the remark of Captain Burton in the 2nd para. of his letter dated 25th November to your address, that Dr. Steinhauser "is a proficient in Natural History, and will be a most useful companion where fever abounds and medical skill is at a premium," the Medical Board beg respectfully to recommend, that Dr. Steinhauser should be furnished with such medicines and surgical appliances as he may consider necessary, to be obtained at the Aden Depot upon indent, countersigned by the Superintendent at Aden.

2. Further, that to assist in the advancement of scientific research, the Meteorological Instruments as stated below may be obtained from the Me-

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dical Stores, Bombay, and placed at his disposal. The instruments being forwarded hence to his address by the next steamer.—I have &c.

(Signed) W. C. COLES, Asst. Surgeon,
Act Sec., Medical Board.

List.	No.
Mountain Barometer	[two 2]
Daniell's Hygrometers	[two 2]
Æther	[lb. ½]
Maximum and Minimum Self-Registering Thermometers	Sets 2
Common Thermometer	No. 6
Thermometer for Altitudes, &c	No. 1

From H. L. Anderson, Esq. Sec. to Gov.
To George Buist, Esq, L.L.D.
Secretary to the Bombay Geographical Society.
29th Nov. 1856.

Sir,—I am directed by the Right Hon'ble the Governor in Council to transmit to you, for the information of the Bombay Geographical Society, copy of a Despatch and of its enclosures, from the Honorable the Court of Directors, No. 38, dated the 24th September last, regarding the employment of Lieutenant R. F. Burton of the 18th Regiment Bombay Native Infantry, to command an Expedition about to proceed into Equatorial Africa under the patronage of Her Majesty's Government.

2. In forwarding these documents I am desired to state, that this Government will be happy to take into its consideration any suggestions which the Bombay Geographical Society may wish to offer, having in view the furtherance of the success of Lieutenant Burton's Expedition.—I have &c.

H. L. ANDERSON, Secretary to Government.

Bombay Castle, 29th November 1856.

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15 *White Hall Place, 6th June* 1856.

Sir,—I have the honor to acquaint you, for the information of the Court of Directors of the Honorable East India Company, that the Council of the Royal Geographical Society has arrived, after a full investigation of the subject, at the conclusion—that the Exploration of the unknown regions of Equatorial Africa, by means of an Expedition from the East Coast, might now be advantageously undertaken.

Proposals to this effect have, at different times, been laid before the Society by various persons, among others by Captain Turner, R. N., Lieut. Ormsby, I. N., and Mr. W. Bollaret, which, for want of the requisite means, have not

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been entertained. The present proposition has, however, been favorably received by Her Majesty's Government, and it is hoped that the Honorable the Court of Directors, having long taken an active interest in this part of Africa, will also contribute towards its success.

The great achievement lately performed by Dr. Livingston, in penetrating from the Cape of Good Hope, through the centre of the Continent to within ten degrees of the Equator, has thrown new light upon the interior of the African continent, and displayed its resources under highly favorable aspects. Other information has also from time to time been received through the Church Missionary Society from Native traders, relating to the countries north eastward of Livingston's route, and to those parts this Society is now anxious to direct its efforts.

In this direction the Interior has been penetrated for any distance by Europeans, but the enquiries of the Missionaries and the investigations of our most learned geographers sustain a report which has prevailed during three centuries that a large body of navigable water exists there, to which access is obtained by various routes constantly traversed by Arab and Native traders, who form caravans from Mombas and other places on the East Coast to the Interior. Although this great mass of water, or inland lake, called by some "a sea," has long since found a place in our Maps, and the Missionaries affirm that they have seen snow mountains to the northward of it, yet no effectual steps have yet been taken to explore this interesting region.

The existence of the lake has been further confirmed in communications from Mr. Consul Brand and the Portuguese Government, describing journeys made by a party of Arab traders, who after traversing the continent from Zanzibar on the East Coast to Benguela on the West, have recently returned from thence to Mozambique. The Arabs described their routes as being well occupied by settled populations, rich in cattle, cultivating the soil, and having plenty of ivory, valued by them at a very low rate. In Dr. Livingston's opinion, active European traffic with that part of the interior which he traversed, would have the effect of developing great natural resources, and the various routes known to be followed by Natives towards the adjacent countries proposed to be explored, favor a similar conclusion.

The Society has, in a former communication, dated March 11th 1850, alluded to the benefits which science has derived from the interest taken by the East India Government for many years in this part of Africa, leading to several successful examinations of the Coast and various journeys inland, accounts of which have been printed in the Journal of this Society. The establishment of an Officer of the Bombay Army as British Consul and Agent for the Company in the Territories of the Imaum of Muscat, for some time past, is also calculated to pave the way for a Mission to the interior the advantages of which are further pointed out in a paper by the present Chairman of the Hon'ble Court, printed in the 23rd Volume of the Society's Journal.

The object of the proposed Expedition, is to penetrate to the Interior of

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Equatorial Africa, from the East Coast in the direction of the lake, to ascertain the nature of the drainage generally of this part of the continent, together with its other natural features, the position of its inhabited places, the character of its people, their resources and condition, and the best means of establishing intercourse with them. The discovery of the Lake and of the parting between the rivers flowing into the East Coast, on the one hand, and towards the North and West on the other, would naturally lead in the direction of the long-sought sources of the Nile, which have never before been attempted to be reached from this quarter. The attempt to solve this problem alone would suffice to attract the interest of the world to the proposed Expedition.

To carry out this important object, the Council places great dependence on the experience and energy of Captain Burton, of the Hon'ble Company's Bombay Army, under whose command it is proposed that the Epedition should be placed. The qualification of this officer as an explorer were laid before the Hon'ble Court by the Council of this Society, in a communication addressed to you, Sir, and dated December 22nd 1852. Since that time, Captain Burton's memorable Journey to Mecca and Medina, and his bold expedition to the African City of Harar, have fully sustained the opinion then expressed. The Council therefore hope, that the Court will be pleased to empower CaptainBurton to engage in the proposed undertaking, his full pay and allowances, while he may be so occupied, being granted to him.

In submitting this proposal to the Hon'ble Court of Directors, I am glad to say, that it has not alone already received the approval of Her Majesty's Government, but, as I am informed, the assurance also of its support to the extent of £1,000 (one thousand pounds.)

It is contemplated that the journey may extend over a period of two years, and as it is necessary that Captain Burton, should be accompanied by assistants, capable of making scientific observations, that he should be provided with presents for the Chiefs, and that his party should be of sufficient strength for the usual emergencies. The Council further trust, that the Court of Directors will take the possible additional expenses of the journey into their consideration, and extend such aid towards it as they may think necessary, not only to secure the effectual exploration of those unknown regions, but also the probable establishment of commercial intercourse with the people of the Interior.—I have &c.

(Signed) NORTON SHAW, Secretary R. G. S.

East India House, 30th *August* 1856.

Sir,—I have the honor to acknowledge the receipt of your letter of the 6th June last, calling the attention of the Court of Directors to a proposed Expedition, aided by Her Majesty's Government, for the exploration (from the East Coast) of the unknown regions of equatorial Africa, and soliciting the assistance of the Court towards the furtherance of this important object.

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In reply I am directed to inform you, that the Court of Directors are willing to co-operate with Her Majesty's Government, in giving effect to a measure which, they believe, will contribute to the general advancement of science, and the development of Eastern commerce, and are therefore prepared, in compliance with the request of the Council of the Royal Geographical Society, to authorize the employment of Captain Burton, of the Bombay Army, on this special service for two years, without prejudice to his position as a regimental officer, on full pay and regimental allowances.

I am directed to add, that the Court of Directors, still further to promote the success of the Expedition, are prepared to issue such instructions to the authorities in India as may be calculated to facilitate its operations, with special reference to the exercise of their influence with the Imaum of Muscat, from whose territory it is proposed that the Expedition should start. I am &c.,

(Signed) J. D. DICKINSON, Dep. Sec.

OUR GOVERNOR IN COUNCIL AT BOMBAY.

1. We transmit to you herewith copies of a letter from the Secretary to the Royal Geographical Society, and our answer thereto, regarding the employment of Lieutenant R. F. Burton of the 18th Regiment of Bombay Native Infantry, with an Expedition, that is about to be despatched in Equatorial Africa by the Royal Geographical Society, with the approval and under the patronage of Her Majesty's Government. Lieutenant Burton has been informed, that he is permitted to be absent from his regiment, and to draw his pay and allowances whilst so employed for a period not exceeding two years, to be calculated from the date of his departure from Bombay.

2. With reference to his correspondence, we desire that you will adopt such measures as may appear to your Government likely to contribute to the success of the Expedition.—We are, &c.

(Signed) W. H. SYKES
" R. D. MANGLES,
and other Directors.

London, 24th Sept. 1856.

H. L. ANDERSON, Esq. Secretary to Government.

Political Department.

Sir,—In reference to your letter of the 28th November, being number 3,400 of 1856, with accompaniments from the Hon'ble the Court of Directors, and the Royal Geographical Society of London, regarding the Expedition into Central Africa under Captain Burton, I am instructed by the Committee of the Society to reply: that it appears to them, that some of the following suggestions might probably be deemed worthy of consideration. They are made in compliance with the wish of the Right Hon'ble the Governor in Council, to meet a merely possible contingency—the Committee not

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doubting that Captain Burton, is fully instructed from higher authorities, and duly impressed with the responsibilities, and duties of the important and honorable enterprize committed to his charge.

2. From an application by Captain Burton to the Society, for the use of an Aneroid, it appears that he has been disappointed in the receipt of his own Mountain Barometer, and that his only instruments for measuring elevations by pressure, are a couple of boiling-point Thermometers.

3. As Captain Burton, is about to cross a great mountain ridge, or table land, and to endeavour to survey a vast Lake, or chain of Lakes, which appear to absorb the River systems of Central Africa, or form the source of the Nile, or some of its branches—questions of altitude become of more than usual interest, and he ought to have a more than ordinarily liberal supply of the means of prosecuting his enquiries. The Committee would therefore recommend that he should have with him at least three or four Barometers, one to be left at Zanzibar for reference, the rest to be carried on along with him (one he has taken with him from the stores of the Society.) That he should have two Aneroids, serviceable chiefly from their portability, with two or three mountain Simpisometers—if the instrument is to be had good at the Presidency,—a matter the Committee deem doubtful. The Society has already provided him with one strong serviceable Barometer by Adie, two or three others should be sent after him—the Government supplies being abundant. He will probably carry one of each kind along with him, and leave a like number at Zanzibar. Captain Burton is doubtless aware, though too many travellers seem to forget, the fact that the value of pressure observations, where accuracy to within 400 or 500 feet is aimed at, depends mainly on having some trustworthy instrument to refer to at the seashore, or at some point of known altitude above it, and that this should be as near as possible to the elevation to be determined. We have no Barometric observations whatever from Zanzibar; the party applied to by the Society and provided with a Barometer in 1849 having failed to carry their wishes into effect.

4. The nearest reference point of known pressure is Aden,—above a thousand miles away, a distance under any circumstances much greater than is desirable—the evil being in the present case aggravated by the prevalence of violent squalls betwixt the Persian Gulf and Cape Guardafui, which sometimes throw down the mercury by half an inch, and thus might create an error in altitude of 500 feet. Captain Burton will, on reaching Zanzibar, be able to judge of the means of carrying on his supplies; and if the Instruments recommended are found more cumbrous than convenient, they need only be left behind.

5. In the course of a Pilgrimage expected to extend over two years, he will have frequent occasion to communicate with the Sea Coast, or may not improbably be joined by companions: in either case he will be able to avail himself of the supplies in his rear.

6. The Society not being aware of the state of his Instruments and instruc-

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tions beyond what has been communicated to them officially, do not in this matter venture on any further suggestion. Captain Burton will doubtless be impressed with the importance of enquiring into the amount of the fall of rain, and of evaporation, in regions abounding with Lakes and Rivers, but which, so far as has been ascertained, send no supplies to the ocean. Geological specimens are so cumbrous that they are not to be expected from the Interior; but the vessel which carries the travellers to Zanzibar may bring back with her, without inconvenience, any amount from the Sea shore; and it will be eminently interesting to know, whether the great Limestone formation—extending in one vast continuous band from the banks of the Burrumputra to those of the Tagus, and from which Captain Burton forwarded valuable specimens from the Somali country—prevails as far south as the Line, and to what distance it extends into the interior it will be desirable to ascertain, whether the upheaved Sea beach—such as that which forms the Esplanade, and is the favorite habitat of the Cocoanut groves around—prevails along the shores of Africa:—and whether, if so, it manifests those signs of a double depression or upheaval, which characterize it in most parts of the world. Both facts may in all likelihood be determined by the appearance of the shore, the inspection of any wells or excavations in the neighbourhood or by enquiries of the people as to whether, in digging downwards, they have met with blue clay, or tree roots underneath the beds of gravel—loose or hardened into masses—forming the upper surface of the beach. Of the £300,000 worth of commerce betwixt Eastern Africa and Western India—the principal part being that of Zanzibar—gums and gum resins form an important part—nearly £20,000 worth being exported from Zanzibar. The most valuable of these are Copal and Gum Animi—the principal supplies being found under ground, from which they are washed out by streams and torrents. Like the Dammer of Singapore and some of the most important Gum Resins of Australia, they may be regarded as semifossils—the produce of forests which have long since disappeared. Our information regarding them is most defective,—anything tending to increase or improve it would be highly prized. We should like to know: whether the *Valeria Indica* which produces it, still abounds as a Tree, as also, what may have been the extent, what the position and circumstances of the extinct Forests, of which it now constitutes the principal trace. The refuse of the Gum Resins used frequently to reach Bombay as *packing*—being deemed of no value. Copal has of late years become so scarce, so much in demand, and so dear that what was formerly thrown away would probably now be considered of value in the market, and there are few of the investigations a traveller can undertake, the people of England value so highly, as those that can be turned to commercial account. Materially to reduce the price of coach varnish would probably be considered to entitle Capt. Burton to a larger share of the gratitude of his countrymen than the measurement of the elevation of the Mountains of the Moon, or the determination of the sources of the Nile. Having thus, in compliance with the wishes of the

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Right Hon'ble the Governor in Council thrown out such suggestions as occurred to them, the Committee direct me again to repeat an expression of their entire confidence in the Expedition, as fully competent to judge of whatever is valuable or attainable.

(Signed) GEO. BUIST, *Sec. to the Society.*

Captain BURTON, Eden Hall.

Geographical Society, 29th Nov. 1856.

Sir,—In reference to your letter of this day's date, applying to the Geographical Society for the the use of an Aneroid—as you had been disappointed in a mountain Barometer expected by the Mail, and no good article of the kind was to be found in Bombay,—I have the honor to state :—

That the Geographical Society has no Aneroid in store, but that they are likely to be had on sale at Smith, Elder & Co.'s or Thacker & Co.'s. Failing this, there are two excellent Aneroids in the Museum, the property of Government, the places of which might be supplied from home, by the time they come to be required by that Establishment. They have been carefully rated by me with the Standard Barometer, as per margin, and it will be seen that No. 8203 differs from this by 00.030.

Temp	80
Bar	29.810
Ane 1,613	29,670
Diff.	140
Bar	29.840
Ane 8203	29.830
	0.130

The Society has two strong Barometers by Adie for sale, and two by Newman, the property of Government, which you may have immediately, as I have no doubt your application will be sanctioned by Government. There is a large supply of beautiful new instruments by Newman in the Medical Stores, while others, I believe, are in the Chief Engineer's Department—to be had by order of Government, or by indent or purchase by sanction of the Military or Medical Board.—I have &c

GEO. BUIST, *Sec. to the Society.*

Dr. Buist then made the following observations on the recent earthquake in the Levant :—It is a curious characteristic of all volcanic commotions of which the earthquake is the most notable, that they are always accompanied by meteorological disturbances. It is probable that the connection is an electrical one ; and that the equilibrium of the electric fluid in the earth becoming disturbed, that of the air is affected. Whatever the cause may be, there is no doubt whatever as to the fact. The late earthquake in the Levant gives us an additional illustration of phenomena, of which we are already sufficiently familiar. Egypt, which on the present occasion has suffered so severely, has in general from the earliest ages been remarkably exempt from earthquakes. So far as is known, the region over which the recent shock was experienced, extended eastwards and southwards to Grand Cairo ;—northwards to Rhodes ; and west as far as Naples. The extreme points are distant from each other about 1200 statute miles. The diameter of the area

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due east and west, seems to be about 1000 miles ; north and south about 600. The following are the points from which accounts have been received, with their longitudes and latitudes. I begin with the westernmost. I have given longitude in time as well as space for Malta, Rhodes and Alexandria, these being the only three for which the hour of the shock is given.

	Lat.	Long.	Time. H.	M.
Naples	40.51 N	14.15 E		
Calabria	35. 0 N	16.28 E		
Malta	35.45 N	14.30 E		059
Corfu	30.37 N	19.55 E		
Rhodes	36.25 N	28.15	1	53
Smyrna	38.30	26.48		
Alexandria	31.12	30.00	2	0
Cairo	30	31.19		
Suez	29.58	32.34		

I have set down Suez on the authority of a Cairo correspondent of the *Morning Herald*, who states that here the earthquake was accompanied by a violent hail storm. If this statement be correct, it is singular that no direct information should have reached us on the subject, especially as the event must have occurred close on the time when the home passengers were on their way through. There is but a small number of the points enumerated from which we have trustworthy accounts of the time at which the earthquake occurred—they are the following. I have given local time first, adding Greenwich time in the second column : subtracting the difference, brings them to a point common time, and shews the rate at which the shock travelled :—

	Local Time.	Greenwich Time	Difference.
Malta	1.49	0.59	0.50
Rhodes	2.40	1.53	0.47
Alexandria	2.55	2. 0	0.55

The distance from Malta to Alexandria is about 1000 miles, and this was travelled in five minutes ; that from Alexandria to Rhodes about 400 ; and this was travelled over in seven minutes.—So that if the time be accurately given the wave was moving nearly thrice as fast westward as northward.—I trust by and bye we may receive tidings of the precise time at which it was observed at all the various points where it was experienced.

There is the more reason to look for this, as most of these were considerable seaports, where the ships' watches may be referred to and depended upon. The railway clock at Cairo was stopped twelve minutes later than that at Alexandria ; unfortunately no reliance can be placed on the time at the latter locality. I have already stated that hail showers were said to have fallen at Suez, but that here, the vibration was very slight. At Cairo the successive vibrations continued for about a minute, and about one hundred and fifty houses with a couple of minarets were shaken down. At Alexandria ew old walls tumbled. No substantial damage was occasioned, but the people

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were thrown into a tremendous panic. At Malta several of the steeples were thrown off the plumb; many of the houses were cracked and rent; the sea rolled back by nearly three feet; but luckily there was no loss of life. At Naples and in Calabria the shocks were long and severe, and mount Ætna vomited forth an unusual amount of smoke and flame. At Rhodes fifty houses were said to have fallen, and the loss of life in the neighbourhood was said to have been heavy. The Austrian Lloyd's steamer *Adria* felt it at sea fifty miles from Rhodes, and the St. Andrew's steamer three hundred miles on her way from Malta to Alexandria, lost one of her masts, and was so severely strained, that she sprung a leak. The usual meteorological phenomena made their appearance. Water-spouts, squalls of wind and violent rain were experienced all around Malta. Here a heavy drought had prevailed for nearly a couple of years, and from the 26th of August to the 16th of October not a drop had fallen. At the latter date there was an alarming gathering of clouds in the air, followed the succeeding morning by a furious thunder-storm with perfect deluges of rain. A farm house was struck by lightning and a man and woman killed. The steeple of Queen Adelaide Church was likewise struck; as also a house in Valetta, in which several people were killed. The storm drew off towards night-fall, but was renewed again with still greater fury next day, when several buildings were again struck with lightning, and those which had been injured by the earthquake were deluged with rain. The Naval authorities were able to collect 14,000 tons of water for the use of the shipping.

Since the admirable papers of Major Baird Smith, published in the *Transactions of the Bengal Asiatic Society* in 1843, we have had no regular accounts of our Indian earthquakes. I have for the last fifteen years regularly cut out from the newspapers, and pasted together, all the published information available on the point, but have never, for want of time, been able to turn it to any further account than making a few catalogues or chronological list. One of these,—in state of tolerable completeness, will be found on the Map accompanying my paper on Indian volcanoes published in our Transactions for 1852. The present year has been rather fertile in earthquakes; the past was somewhat barren. On the 11th February 1855, a severe shock of the earthquake which lasted full twenty seconds, visited Meerut and Roorkee, just after day-break; while a shock was felt at Kurrachee, the same morning about three. On the 17th March a succession of shocks were felt at Meerut, Allyghur, Delhi, and Muttra; and on the 19th of June a slight shock at Jacobabad upon the Northern Scind frontier. These are all I find set down in my list for last year. On the 17th of January a severe shock of earthquake occurred at Delhi. On the 2nd of March last, a series of tremendous earthquakes and volcanic eruptions prevailed over Cœlebes and the Moluccas, during which twenty thousand lives were said to have been lost. I do not observe that any signs of this manifested themselves in any part of India—From the 6th to 9th of April last, a constant series of slight shocks were experienced all over the Punjaub.

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The Monthly Meeting of the Bombay Geographical Society was held in its Rooms, on Thursday the 19th February 1857, at half past four P. M.

Present.—Rear Admiral Sir Henry Leeke, Commander-in-Chief of the Indian Navy, Prdsident in the Chair, W. E. Frere Esq., C. S.; E. Leggatt Esq., Lieut. D. J. Kennelly; H. Liardet Esq., (visitor); and R. S. Sinclair Esq., Acting Secretary.

The minutes of the last Meeting were read and confirmed.

Letters read.—No. 5803 of 1856, from H. L. Anderson, Esq, Secretary to Government, Political Department: No. 11 of 1857, from John Mawson, Esq., Acting Secretary to the Bombay Chamber of Commerce: No. 8 of 1857 from E. H. Furgusson, Esq., Lieut. I. N., superintendent of Government Observatory; No. 221 of 1857, from Colonel Melvill, Secretary to Government, Military Department; letter from C. S. Sinclair, Esq., letters from C. Weedmann, Librarian, and from Dr. Martinez, Secretary, Royal Bavarian Academy, Munich.

Presents to the Library.—1. Naturiorssenschaftliche Abhandlungen Gesammelt von *Wilhelm Haidinger*.

2. Abhandlungen der Kaiserlich—Koeniglichen Geologischen Reichsamstalt.

3. Jahrbuch der Kaiserlich Koeniglichen Geologischen Reichsamstalt (Parts 5, 6, 7.)

4. Journal Asiatique (Parts 6, 7.)

5. Report of the Bombay Chamber of Commerce for 1855-56.

6. Journal of the Indian Archipelago and Eastern Asia.

7. Contributions to the Meteorology and Hydrology of the Indian Ocean.

8. Colonel Alexander Walker's Reports on the Province of Kattywar and the Ceded Districts in Guzerat.

9. Magnetical and Meteorological Observations made at the Hon'ble East India Company's Observatory, Bombay, in the year 1854-55 under the superintendence of Lieut. E. F. T. Furgusson, I. N. F. R. A. S.

The best thanks of the Society were voted to the donors for these presents to the library.

In reference to the following extract from the letter of Dr. Charles V. Martinez, Secretary Royal Bavarian Academy Munich: "I should be very thankful if you give me some account of a Botanist to whom I could apply for a mutual correspondence and exchange of dried plants (or books) I am particularly interested in knowing the Palmæ in the Flora of Bombay amongst which the *Borassusdichdtoma*) (*Kulpavroochum*, Sanscrete) is totally unknown to me," the Acting Secretary was directed to communicate with Dr. Gibson, Conservator of Forests.

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Also it was agreed, that the Society would be happy to become the means of communication between Dr. Martinez and any person interested in the subject of Botany. Should a more direct correspondence, however, be considered desirable, the Society wish it to be known that "Willams and Norgate, London" was suggested to themselves by Dr. Martinez, as being one of the least expensive channels of intercourse.

In reference to the letter from C. Weedmann, Librarian to the Royal Bavarian Academy of Sciences, thanking the Society for vol. xii. of its Transactions, and desiring a copy of vols. i—viii. and xi., it was stated that the first impression of the earlier volumes of the Society's Transactions having been exhausted, another impression was in progress. It was then resolved that, as soon as reprinted, a copy of the above mentioned volumes be forwarded.

At this meeting of the Society no regular paper was read. But the President and other members present, dwelt with much interest on the desirableness of trying M. Foucault's pendulum experiment for exhibiting the rotation of the earth, in Bombay with the necessary degree of accuracy. It was stated that under much more unfavorable geographical circumstances, the experiment had been made in Ceylon (Lat. 6 56) by Lamprey and Schaw with very creditable experimental results; the hourly motion of the place of the pendulum's oscillation being 1.870 according to experiment, whereas the amount, as deducible from theory, should have been 1.815°. The geometrical considerations involved in the problem were briefly stated, which lead to the following formula that the motion for Mean Solar Hour of the plane of vibration of a pendulum at any place on the earth's surface is equal to 15.0411 multiplied by the *sine* of the Geographical latitude of the place.

M. Foucault's own experiments were conducted on a very grand scale, in a good latitude (48° 50), and with excellent appliances. The upper end of a steel wire, of about 64 mètres in length, was encased in a metallic plate fixed to the centre of the cupola of the Pantheon, while the lower extremity supported a heavy ball of copper. The pendulum thus formed effected its oscillations very slowly; the duration of each of them occupying about 8 seconds of time. The result of the series of experiments gave 11.500° as the hourly motion, theoretic computation assigning 11.323°. In some other places of the earth, experimental results have approximated still more closely than M. Foucault's to those of calculation, sometimes erring in defect, sometimes in excess. Not having at hand a larger number of experiments, the following carefully determined figures may be cited as affording matter of interest. The Latitudes have been determined by independent means; the hourly motion of the plane of the pendulum has been observed by the annexed names; and the assigned times of rotation of the earth have been several-

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ly computed from the motions by aid of the formula already stated.

Place.	Lat.	Observed Hourly Motion.	Observer.	Time of Rotation
				H. M. S.
Ceylon....	6o 56'	1o.870	Lamprey & Schaw.	23 14 20
New York.....	40 44	9·733	Loomis.	24 8 9
Providence R.I...	40 49½	9·955	Carswell & Norton.	23 38 29
New Haven C.T. .	41 18⅝	9·970		23 50 7
Geneva	46 12	10·522	Dufour & Wartman	24 41 39
Paris.	48 50	11·500	Foucault.....	23 33 57
Bristol.	51 27	11·788	Bunt.	23 53 2
Dublin.	53 20	11·915	Galbraith & Haughton. ..	24 14 7
• Aberdeen.	57 9	12·700	Gerard.	23 48 49

It is curious to observe that the mean of the above times of rotation is 23*h*. 53*m*. 37*s*. differing by less than 2¼ minutes from the true amount for a period of nearly 24 hours. Considering the experimental difficulties to be encountered, these figures are very close.

It was stated by one of the members, that not being acquainted with any results by the pendulum for latitudes near that of Bombay, as well as for its local interest, he had begun to make some observations in the Central room of the Government Industrial Museum ; the ceiling of which room however was much too low. This fact independently of drafts of air, would render the observations less useful. The cupola of the Town Hall was mentioned as being apparently the most suitable place for suspension in Bombay. The President, Mr. Frere, Lieutenant Kennelly and other members contributed suggestions as to meeting the practical difficulties ; but the official occupations of the members seemed to tender it impossible for them to devote to the matter at present the necessary time.

The Monthly Meeting of the Bombay Geographical Society, was held in its Rooms, Town Hall, on Thursday the 23rd April at ½ past 4 P. M.

Present,—Rear Admiral Sir Henry Leeke, Commander-in-Chief of the Navy, *President*, in the Chair.

The minutes of the last Meeting were read and confirmed.

Letters Read.—From W. H. Carry Esq., Thomason College, Roorkee. From Messrs. Smith, Elder & Co., Cornhill, London. From Mooltan, April 4 From Captain R. McLagon, Officiating Principal, Thomason College 28th March. From Thomas Oldham Esq., Superintendent of the Geological Survey of India, and of the Geological Museum Calcutta. January. From W. C. Coles Esq., Secretary to the Medical and Physical Society of Bombay. 2nd March, No. 1572 of 1857 from Colonel Melvill, Secretary to

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Government, Military Department. No. 1603 of 1857 from H. L. Anderson, Esq., Secretary to Govenment Political Department. From Dr. Downes forwarding at the request of Captain Furshard, I. N., a record of observations made from Zanzibar to Aden, also extracts from the log of the Brig Helena from Zanzibar to Seeshikles and back. From Dr. Gibson, Conservator of Forests, stating he would take an early opportunity of communicating with Dr. Martinez, and expressing the hope that he would be able to send him a supply of the fruit of the Borassus Dichotoma during the present year.

PRESENTS TO THE SOCIETY.

1. Memoirs of the Geological Survey of India.

2. Miscellaneous information connected with the lapsed Sattara Territory, and the districts belonging to the Sattara Jageerdars.

3. Transactions of the Medical and Physical Society of Bombay for the year 1855-56.

4. Reports on the proceedings of the officers engaged in the magnetic survey of India.

5. Correspoodence relating to the Tenure of the possessions in the Deccan held by His Highness Jyajee Rao Sindia under the treaty of Surje Anjungaum.

6. Report on Vaccination throughout the Bombay Presidency and Sind, for the year 1855.

7. Papers regarding the Revenue Settlement effected in the Districts of Omerkote and Thurr; and on the condition and system of management of the Thurr and Parkur districts.

8. Annual Directory and Calendar for the N. W. Provinces, Punjaub and Oude for the year 1857.

9. The Almanac and Companion for the North-west Provinces and the Punjaub for the year 1857.

10. Proceedings of the Royal Geographical Society of London.

11. A Memoir on the Ancient Reservoirs lately discovered, and now in course of restoration at Aden.

12. Russia at the close of the sixteenth century, comprising the Treatise "of the Russian Commonwealth," by Dr. Giles Fletcher, on the Travels of Sir Jerome Horsey, Knight, now for the first time printed entire from his own manuscript.

13. Proceedings of the Society of Antiquities of Scotland. Vol. 2 part. 1.

The thanks of the Society were voted to the donors for these contributions to the library.

The President then called on Mr. Leggatt, who spoke much to the following effect in illustration of a vast variety of excellent specimens of ferns which

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were exhibited at the meeting. The principal were the following, gathered on the Neilgherries in the year 1854.

1. Adiantum Capillus Veneris
2. Asplenium Strigollossum.
3. Asplenium Planicaule.
4. Asplenium Raaberhizon.
5. Asplenium Bulbiferum.
6. Asplenium Appendiculatum.
7. Asplenium Felix Femina.
8. Nothochlœne Squamosa.
9. Nothochlœna Rufa.
10. Nothochlœna Agentia.
11. Nothochlœna Nicea.
12. Niphobolus Lingua.
13. Niphobolus Pertusus.
14. Niphobolus Rupes-tris.
15. Polypodium Longipes.
16. Polypodium Longipes Femina.

The Fern is a weed, in Botany of the Cryptogamia class, very common in dry and barren places, and is very injurious to the land in which it has once taken root. Between the tropics several species like the Asplenium Bulbiferum. form small trees, having something of the aspect of palms, and are considered one of the greatest ornaments of those regions. In the Phillipine Islands, particularly in Mindora, they grow luxuriantly and their branches shoot almost to the water's edge which forms a pretty contrast with the white sandy beach it overlaps. Ferns have different degrees of organisation some have stems, and leaves, and a sort of wood, others again consist of simple threads or look as a collection of little grains. Between these two extremes, there are various conditions of stem and leaf; the two often growing into each other and forming only a thin expansion. Ferns have no flowers or seeds and therefore their manner of fructification is remarkable; they are generated by little embryo plants called spores, being a number of contained cells in little clusters of capsules from which new plants are produced. In most ferns little brown spots may be seen on the under sides of the leaves, as for instance, like the Niphobolus Rupes-tris. Each of these brown spots is composed of a quantity of very minute membranous capsules which contain the reproductive germ furnished by nature with a sort of elasticity to assist in its dispersion.—In speaking of natural Elasticity, it must be remembered that one of the peculiar phenomena of vegetation is the irritability of some plants, that they possess a sort of nervous system, dependent on atmospheric influence and various other causes. We have only to refer to various flowers in this country, like the sun and moon flower, to remark the direct influence those celestial bodies have on them. In England the evening primrose will not open its yellow flowers till the sun has fully set, and the cereus only expands into blossom at midnight; again the irritability produced by external touch to some plants is familiar to most persons, even so, there is a peculiar irritability about ferns, little understood, which propagates these little embryo plants,—in most species these brown spots called *sori* are protuberating, which on the sligtest breeze is ruptured and its contents discharged. As on order, ferns are very widely distributed, there are upwards of two thousand species now known and very many of them are grown in Great Britain. Ferns, owing to their beauty, variety, and singularity of reproductive organs, may well rank with the best of cultivated plants.

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They are found in different parts of the world in all shapes, sizes, and colours, some species grow to the height of 20, 30, and 40 feet, others a foot high, and some bear the resemblance of creepers. They are seen growing on the Neilgherries, in Mysore, in Burmah, in the Mauritius, and China, as well as growing wild in some of the Islands of the Pacific. The specimen I have chosen for this evening is the Adiantum Capillus Veneris or Dry Venus Hair Fern, gathered on the Neilgherries in. 1845, it is very commonly known too by the name "of Maiden Hair Fern," it is so perfect, and every portion of it entire, that it is a source of gratification to me to be able to produce it in that state before the Society this evening,—for Professor Lowe in writing of the specimen in his valuable work on Ferns lately published, styles it "the only British representative of this delicately beautiful family." It is grown in England principally under pot culture, sometimes in a hot-house, as a warm temperature is said to be essential to its wellbeing. Professor Lowe and Dr. Hooker both in writing on this Fern, state that frost is injurious to it, and the former writes, "the great cold of 1853 destroyed all the plants in the Fernery at Highfield house." This seems very strange, for I know it as a fact from where this specimen was gathered that no care was bestowed on its growth, for it was found wild among the rocks on the Hills and persons who have been resident there, will be ready to certify to the truth that frost and cold are both felt severely in their season on the Neilgherries. Moore who has very lately written an excellent work with very elegant painted prints of Ferns grown in Great Britain (a copy of which through the kind permission of Mr. Taylor of Messrs. Smith Taylor and Co.'s Firm, I am able to lay before the meeting this evening and to whom my thanks are due for the privilege) states of the Adiantum Capillus Veneris "that it is a delicate plant, will not even stand the cold inside of a warm house, and is by no means a hardy fern." Yet in remarking of its geographic range, both Lowe and Moore as well as Dr. Hooker describe the following Indian localities where it is to be found :—Malabar, Simla, Scinde, Affghanistan, Beloochistan, &c. Now Simla, in consequence of its low temperature is considered highly salubrious, the winter there is described as sometimes very severe and in 1836 snow is said to have laid on the ground in the month of January and February to the depth of six feet and appears not to have melted away for some time—the height of the encampment is stated to be nearly 8,000 feet above the level of the sea, and the highest point of the Neilgherries where this fern may be found, is nearly 9,000 feet. Scinde, we all know at certain seasons of the year, is very cold and as for Affghanistan and Beloochistan they are known to have winters which at times are any thing but mild. My object in remarking on the temperature of these localities is, that I wish to show that whatever cold may do in England to prevent the full development of this Fern, in India and other places to the eastward of it, cold is conducive to its well being, and tends to harden, and strengthen its growth. On the Neilgherries, it is found to grow to the height of 18 inches

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to 2 feet, in Burmah up the Arracan River about Chyndook it is seen as a wild creeper, in China it grows in a woody manner 3 or 4 feet high, while in England it rarely grows as high as sixteen inches. According to the strength of the tree or plant, the leaves are found more membranous and are in all places a beautiful evergreen. In some parts the little brown spots are plainly visible on the fronds, as in the specimen before you, in others just like delicate moss on the stem, and in some there is nothing visible to the naked eye, but with a microscope may be discerned small hairs growing on the tips of the leaves. In conclusion, the medicinal properties are very peculiar and wonderful in this fern, the leaves contain an astringent mucilage, which the Burmese and natives of India use as a tincture for cough, and cold, the root when boiled is a purgative and regarded among the Chinese in the same light as we do Rhubarb and the same root, if burnt, yields a considerable quantity of Alkali.

During the conversation which followed Mr. Leggatt's communication, Mr. H. B. E. Frere remarked that this beautiful species of fern was found at Hinglaj, a remote place of pilgrimage in Mekran, and that native visitors, thinking it the only place in the world where it is found, are in the habit of taking pieces of it away. However the late Dr. Stocks, very much to their mortification, undeceived them by exhibiting dried specimens from the Himalayah and from England.

Dr. Bhawoo Dajee exhibited a specimen of the Adiantum Lunulatum.

The President then called on Dr. Bhawoo Dajee, who gave a very interesting description of a variety of Palbrow found in the Presidency, including the Borassus Dichotoma, amply illustrated by specimens. It is to be regretted that the author has not yet found time to furnish an abstract of his instructive discourse.

The best thanks of the Society were voted to Messrs. Leggatt and Bhawoo Dajee for their communications.

The Annual General Meeting of the Bombay Geographical Society was held in its Rooms, Town Hall, on Thursday, the 21st May 1857, at 4½ P. M.

The Minutes of the last Meeting were read and confirmed. The following report gives the state of accounts of the Society for the year, May 1st 1856 to April 30th 1857, and the changes which have taken place in the list of our members.

1856	*Receipts.*				
1st May.		Rs.	A.	P.	
To Balance in the hands of Treasurers.....		1032	8	2	
Ditto Secretary		46	4	9	
					1078 12 11

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To Annual Subscriptions of Members, together with Rs. 100 communication.	986	0	0
„ Philosophical Instruments sold.	123	0	0
„ Society's Transactions sold	17	8	0
„ Interest on Treasurer's account up to 31st July 1856	40	2	3
Rs.	2,845	7	3

1856 *Disbursements.*

May 1st.	Rs.	A.	P.
By Office Establishment for the year	600	0	0
By Cash paid for contingences additional to Government allowance	140	6	3
By Bill of Exchange remmitted to Messrs. Smith Elder & Co., London	79	11	3
By printing and advertising from June 1856 to February 1857.	1322	6	0
By Commission to 31st July 1856	12	1	8

1857

April 30th

By Balance in Tresurer's hand at this date	Rs.	643	3	7	
By ditto in Secretary's hand		47	10	6	
					690 14 1
Rs.					2,845 7 3

Assets.—Instruments on hand on the 30th April 1857.

4	Sympesometers at Rs. 55 each	220	0	0
3	Adie's Thermometers at Rs. 13 each	39	0	0
2	Large Compasses at Rs. 3 each	6	0	0
11	Small ditto at Rs. 2½ each	27	8	0
31	Triple Lenses at Rs. 2½ each	77	8	0
35	Double ditto at Rs. 1½ each	52	8	0
33	Single ditto at 1 Rs. each	33	0	0
5	Barometer Tubes at Rs. 12	60	0	0
Rs.		515	8	0

Net Balance in the hands of the Society	690	14	1
	515	8	0
Rs.	1206	6	1

[The Acting Secretary overlooked four Large Barometers one with Captain Burton, one with Major Barr, one with Lieut. Twyford, one with Principal Harkness, three of which have since been returned.—G. B. *Secretary.*]

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Members.—We have to deplore the loss by death of two of our oldest Members, Colonel Neil Campbell, Quater Master General, Bombay Army, and Commodore R. Ethersey, I. N.

The following Members are at present in Europe:—W. P. Adams, Esq., Henry Young, Esq., C S.; Richard Willis, Esq.; A. Robertson, Esq., C.S.; J. M. Erskine, Esq., C. S.; C. Kingcome, Esq.; Nowrojee Furdoonjee, Esq.

Returned from Europe.—The Hon'ble J. G. Lumsden; Captain G. Jenkins, I. N.; Commander W. C. Barker, I. N.

The following Members have retired from India:—Colonel J. Holland N. I., and William Howard, Esq.

The following Office-bearers were elected for the ensuing year.

Vice-Presidents.—The Honorable Arthur Malet; W. E. Frere, Esq., C. S.; C. J. Erskine, Esq., C. S.

GENERAL COMMITTEE OF MANAGEMENT.

Resident Members of Committee.

H. L. Anderson, Esq., C. S.	Lieutenant Furgusson.
Dr. E. Impey.	Lieutenant Constable.
J. J. Berkeley, Esq.	Cursetjee Jemsetjee, Esq.
W. F. Hunter, Esq.	Narrayen Dinnanathjee, Esq.
Major Phayre.	Bhaoo Dajee, Esq.
Captain Jenkins.	R. S. Sinclair, Esq., L.L D.

Non-Resident Members of Committee.

P. W. LeGeyt, Esq., C. S.	Commander Jones.
General J. Jacob.	Captain A. B. Kemball.
Lieut. Colonel LeGrand Jacob.	Lieutenant Grieve, I. N.
Dr. Winchester.	Lieutenant A. D. Taylor.

Letters Read.—Letter from Mr. De Souza, Printer, accompanied by a copy of the forthcoming Transactions, as far as printed. Letter No. 1061 of 1857, General Department, from W. Blowers, Esq., Deputy Post Master General. Letters from George Simson, Esq., of the Stuart Wortley, dated May 11th and 21st. Letter from Dr. Carter, Editor of Geological Papers on Western India, May 21st. Letter from J. W. Hurst, Esq., Secretary to the Bombay Mechanics' Institution.

Presents to the Library.—1. 2.—Jahbruch der Kaiserlich Koninglichen Geologischen Reichsaustalt, 1856 vii. Jahrgang, No. 2 and No. 3.

3.—Reports of the Juries of the Madras Exhibition of 1855.

4.—Address delivered at the Annual Meeting of the Bombay Mechanics' Institution, April 11th 1857, by the President James J. Berkely, Esq.

5.—Geological Papers of Western India, &c., Edited for Government. By H. J. Carter, Esq. Assistant Surgeon, H. Co.'s Service, Bombay.

6. Atlas to ditto. By H. J. Carter, Esq., Assistant Surgeon, H. Co.'s Service, Bombay.

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The thanks of the Society were voted to the donors for their contributions to the Library.

The Weather book of George Simson, Esq., " on the Phenomena observed from the Equator up to Bombay at the commencement of the Monsoon" was, by the courtesy of that gentleman, laid on the table for the inspection of the Members of the Society.

The Ordinary Monthly Meeting of the Bombay Geographical Society, was held in its Rooms, Town Hall, on Thursday the 16th July at 4½ P. M. Colonel LeGrand Jacob in the Chair.

The Acting Secretary stated that he had received a note from Rear Admiral Sir Henry Leeke, the *President*, expressing his regret that he had not known that a meeting of the Society would be held on the 16th, sufficiently early to have altered his arrangements about setting out for Poona.

The minutes of the last meeting were read and confirmed.

Letters Read.—1. Letter from Captain Jenkins I. N., dated May 28th 1857.

2. Letter from Dr. Alexander Gibson, Conservator of Forests, dated May 29th.

3. Letter No. 2382 of 1857, dated May 26th, from H. L. Anderson, Esq., Secretary to Government, Political Department.

4. Letter No. 4 of 1857, dated June 11th 1857, from W. Hart, Esq., Secretary to Government, Public Works' Department.

5. Letter No. 83 of 1857, dated 20th June 1857, from Dr. Giraud, Acting Principal of the Grant Medical College.

6. Letter No. 3163 of 1857, dated June 6th 1857, from Colonel P. M. Melvill, Secretary to Government, Military Department.

Presents to the Library.—1. Memoirs, By Commander James Felix Jones, I. N. connected with Bagdad; Nahrwan Canal, Frontier of Turkey and Persia; Median wall of Xenophon and discovery of the Ancient Opis; Topography of Nineveh &c.

2. Report of Captain W. S. Merewether, Acting Political Superintendent, Frontier of Upper Sind, with other papers relating to the enlargement of the Begaree Canal, in upper Sind.

3. Journal of the Royal Geographical Society. Volume the twenty-sixth.

4. Annual Report of the Grant Medical College, Bombay. Eleventh year session 1856-57.

5. Reports on the proceedings of the officers engaged in the Magnetic Survey of India.

6. History of the new world, by Girolamo Benzoni.

7. Results of the Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich 1855.

In accordance with Rule IX., the Society proceeded to elect from the Resident Members of the General Committee, the following Chairman and Members of the Sub-Committee of Accounts and Sub-Committee of correspondence.

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Sub-Committee of Accounts.

W. F. Hunter, Esq. Chairman. Major R. Phayre ; Lieutenant Fergusson ; Lieutenant Constable ; Cursetjee Jamsetjee, Esq. and Narrayen Dinnanathjee, Esq., Members.

Sub-Committee of Correspondence.

H. L. Anderson, Esq ; Chairman; Dr. Impey ; Captain Jenkins ; J. J. Berkeley, Esq. ; Bhawoo Dajee, Esq. ; R. S. Sinclair, Esq.—Members.

The Chairman having stated that he had taken some notes of a journey through the Thur Desert some years ago, in the course of conversation thereupon it was proposed by Jagonnath Sunkersett, Esq. and seconded by W. T. Roper, Esq. and concurred in by the other Members present, that Colonel LeGrand Jacob be invited to prepare a Memoir of his journey through the Thur Desert for insertion in the volume of the Transactions which will appear after the next, namely for that of 1858. Colonel LeGrand Jacob stated he had much pleasure in complying with the wishes of the Society.

The Ordinary Monthly Meeting of the Bombay Geographical Society, was held in its rooms, Town Hall, on Thursday the 24th September 1857, at 4½ P. M.

Letters read.—1. From the American Geographical and Statistical Society, New York, 22nd May 1855.

2. From the Smithsonian Institution at Washington, of February 13th 1854, and July 10th, 1855.

3. From H. L. Anderson, Esq., Secretary to Government, No. 1713 of 1857, dated 7th September 1857, enclosing an extract from a letter from Captain R. F. Burton, commanding expedition into Equatorial Africa, dated Zanzibar 23rd April.

4. From J. H. Hofmery, Esq.. District Rivendate, Cape of Good Hope, dated 20th May, enclosing a bottle log.

5. From Rear Admiral Sir Henry Leeke, dated 13th September.

6. No. 70 of 1857, dated 23rd September, from Lieutenant E. F. J. Fergusson, I. N., Superintendent Government Observatory.

Presents to the Library :—1 Document relating to the Colonial History of the state of New York, vols. 3 and 4.

1. Reports of the Legislature of the State of New York.
2. Rail Road Statistics, 1854 and 1855.
3. On the Canals, 1854 and 1855.
4. Of the Superintendent of the Banking Department, 1855.
5. Of the Commissioners of Emigration.
6. Of the Governor of the Alms House.
7. Bulletin of the American Geographical and Statistical Society.
8. Smithsonian Contributions to Knowledge, vol 7.

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9. Ninth Annual Report of the Board of Regents, of the Smithsonian Institution.

10. English Annual Report of the Board of Regents, of the Smithsonian Institution.

11. Report and Charts of the Cruise of the W. S. brig *Dolphin* with a map.

12. Bulletin De la Societi De Geographic. Paris.

13. The Journal of the Bombay Branch of the Royal Asiatic Society for 1857.

14. Report of the Juvenile Improvement Library, read at the fifth annual meeting, held August 8th 1857.

15. Magnetical and Meteorological Observations made at the Honorable East India Company's Observatory, Bombay, for 1856.

16. Mittheilungen Der Kaiserlich—Koniglechens Geographischen Gesellschaft Jahrgang 1857. Wien.

The bottle log, referred to in letter 4 above, bears the following account:—"No. 73. This bottle, with its enclosure, was thrown from on board the ship *Malta* on her way from Bombay to London, at noon on the 8th day of April 1857. Observations:—Lat. 35 28' Long. 21° 9' E. Picked up at Steinkool Fontein, twenty miles E. of Port Beaufort, Cape of Good Hope, 12th May 1857."

Mr. Hofmery, who forwarded the above, states the bottle "was found on the beach entangled in sea weed," and adds—"As the part of the coast is but thinly inhabited, I cannot with certainty state how long the bottle might have been there before I found it."

After the reading of Sir Henry Leeke's letter, resigning the office of President, which he held for upwards of five years, it was unanimously resolved:

I. That Rear Admiral Sir Henry Leeke be elected an honorary member of the Society.

II. That the members now present form themselves into a Sub-Committee to acknowledge the receipt of the late President's resignation, and to return him the thanks of the Society for his exertions in its behalf, to be forwarded by the next mail.

Member Proposed.—Commodore George Wellesley, Commander-in-Chief of the Indian Navy; proposed by W. E. Frere, Esq. *Vice President*; seconded by Venayeckrow Jugonathjee, Esq.

A Meeting of the Bombay Geographical Society took place in its rooms on 15th October, W. E. Frere, Esq., in the Chair. The attendance was less numerous than it probably otherwise would have been, in part from the absence of members from the Presidency for the holidays, in part from the exciting scene at that hour passing on the Esplanade. (The execution of the Mutineers.)

Commodore Wellesley having been elected member of the Society was,

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Information that might be collected in connection with the soundings in contemplation, in anticipation of laying down a Telegraphic wire from Suez to Bombay.

The United States' Government have set an example which all the great powers of the world are following—on the subject of the deep sea soundings, sub-surface currents, and other hydrographic enquiries, not only appertaining to navigation, but as bearing on great questions of physical science.

The operations connected with the soundings likely to be immediately required, in contemplation of telegraphic communication betwixt Suez and India, promise to afford opportunities for the prosecution of other enquiries of the deepest interest to the philosopher.

The first of these is, the examination into the speed and direction of the sub-surface currents, a succession of which will most likely be found to prevail at different depths in the sea.

In 1850, the Bombay Government authorized me to get an instrument constructed at the steam factory for the purpose:—the first plan did not succeed: I subsequently constructed, at my own charge, a second instrument, which, after the introducton of several alterations suggested by the late Admiral Beechy, Captain Washington and Captain Beecher, was pronounced entirely satisfactory. It is now in the possession of the Hydrographer to H. M.'s Lords of the Admiralty. The original of this is in my possession, and may be completed, if desired, at the charge of about Rs. 50; or the enquiry might be pursued on the old system, as described by Mr. Maury in his reports. It would be of the utmost interest to have this matter enquired into in the Gulf of Aden. One of the two cruisers commonly lying idle there might push out into mid-channel, and accomplish all that is required—while the boats or vessels now constantly at Perim, might examine the surface and sub-surface currents of the Strait.

I have two instruments at disposal,—nearly identical, as they turned out to be, with Dr. Marcet's bottle,—for drawing water from any depth under the surface; and as we have now a valuable series of observations on the saltness of the sea at the surface, from Suez to Bombay, it would be important if this could be compared with its saltness at great depths.

In moderate depths, it would be eminently desirable to obtain specimens from the bottom by the use of armed leads; and as at each sounding, the survey vessel will be from 10 to 20 hours nearly at rest, valuable opportunities will occur for enquiries into marine zoology—such as are there daily presenting themselves. The Surgeon of the ship on whom this division of research devolves, should be provided with a microscope, and the means of preserving soft specimens.

We are, up to the present time, in a great measure in the dark as to the Hygrometry of the atmosphere at considerable distances from the shore:—evaporating dishes may easily be employed in still weather with the ship at rest, and Hygrometers of all sorts at all times.

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MINUTE BY MEMBERS.

Minute by Commodore Wellesley.—Any information or suggestion that any member could give upon the subject of deep sea soundings would be very desirable, as preparations are making for trying the depth across to the Kooria Mooria Islands by Aden.

MEMORANDUM ON THE INFORMATION DESIRABLE FROM THE PERSIAN GULF.

Captain Jenkins, just appointed Commodore in the Persian Gulf, was the first of our members who communicated to the Society information regarding its islands.

Ormuz,—of the sulphur of which an account by him was published in an early number of our Transactions,—is said to be a volcano. We want drawings and specimens of the rocks to verify the fact; and wish to know how far the volcanic field extends around.

At the last Meeting of the Society, beautiful specimens of sulphur from Ormus were exhibited by Dr. Burn: these were stated to have been found crystallized, on the surface of masses of rocksalt, and in this case seem more likely to be the result of decomposition, than of sublimation or of fusion. Careful examination, and a profusion of large specimens, would throw light on one of the most curious questions in physics.

Some very excellent papers by Dr. Winchester have been published on Karrack and the adjoining countries. Specimens for the illustration of these are desired.

The manufacture of candles from petroleum, of which vast supplies are said to exist near Bussora and Bushire, makes information on this subject desirable in an economic, as well as in a scientific point of view: and a good account of the petroleum wells in Arabia or Persia, might be the foundation of a reputation, and something more substantial.

The same information in reference to subsurface currents, and other matters derivable from the deep sounding survey, would be important from the Persian Gulf.

G. BUIST.

MINUTES BY MEMBERS.

The information sought on the subjects mentioned in both memos. is of a very valuable character to science. It can only be acquired in vessels employed in similar capacity to that described in Dr. Buist's 2nd and 3rd paras.

As it will rest with the President, in his official capacity of Commander-in-Chief of the Indian Navy, to instruct officers on the subjects of research brought forward, I would suggest that he be solicited that he should permit them to be undertaken and give them his support, and that Dr. Buist be requested to draw up definite instructions as to the information required, providing instruments at the Society's expense.

E. IMPEY.

As the opportunity which will occur, when sounding the sea for the electric wire, will be one that will not again perhaps offer itself, I think all prac-

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ticable methods should be tried to ascertain the speed and direction of sub-surface oceanic currents, as well as the temperature and saltness of these at different depths from its surface to the bottom. Not only this, but specimens of the bottom should, if possible, be got at every cast of the lead, their character carefully noted ; and when those specimens are of an extraordinary nature, they should be carefully preserved in glass stoppered phials, and made over to the Government Museum or some scientific society's museum. It is my opinion, that the obtaining the data above desired, should not be left to change, but be required as a portion of the duty of the officer entrusted to take the soundings, and Government be requested to furnish such instruments as may be required.

The Secretary might draw up a memo. of (and the expense of) such instruments, rules of using, form of journal to be kept &c. &c. &c., and submit the same for the sanction of Government in the name of the Society.

E. P. FERGUSON.

The Secretary stated that he entirely concurred in the excellent observations of Dr. Impey and Mr. Ferguson, and should feel much gratification in undertaking any task entrusted to him by the Society. Two of the instruments referred to were on the table—that called Dr. Marcet's bottle had been constructed without his knowing of the existence of the contrivance originally bearing the name, and on comparing the two, they were found pretty nearly identical. Those now on the table had been made at the School of Industry, and cost some fifteen or twenty Rupees a-piece. The sub-surface current measuring machine is nearly the same as that deposited with the Hydographer to the Lords of the Amiralty, which had been tried and found perfectly efficient. There were a number of improvements which subsequent experience suggested, but the whole might readily be constructed for fifty Rupees. At the same time, it would be well to have as a substitute, in a service where instruments are so apt to be lost, a good supply of the old contrivances specially described by Maury. He says :—

" The next subject to which I would refer, is our investigation of the *under-currents* of the ocean. I regret we had so few opportunities for these very interesting experiments ; but enough has been done to seem to warrant the conclusion, that these undercurrents are *generally* stronger, setting in various different directions, than those of the surface. I am well aware that there is no mode of testing their *exact* velocity ; but that practised by myself, which I will describe, was certainly all sufficient to show their relative velocity. There may be none so rapid as that mighty oceanic river, the *Gulf Stream* : unfortunately, the weather prevented our making these investigations in that interesting region ; but in the various parts of the Atlantic in which we succeeded in these experiments, on only two occasions did we find the undercurrent of less velocity than that running in a different direction above it. The following is the mode practised in testing them.

The surface current was first tried by the usual mode (a heavy iron kettle

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being lowered from a boat to the depth of 80 fathoms) ; then, for the trial of the undercurrent, a large *chip-log*, of the usual quadrantal form, the arc of it measuring full four feet, and heavily loaded with lead to make it sink and keep upright, was lowered by a light but strong cod-line to the depth of 126 fathoms, (the length of the line :) a barrega was attached as a float, a long-line fastened to this barrega, and the rate of motion of this float, as measured by this long line and the glass, as well as the direction as shown by a compass, were assumed as the velocity and set of the undercurrent. No allowance was made for the drag of the barrega, which was always in a different direction from the surface current. It was wonderful, indeed, to see this barrega move off against wind, and sea and surface current, at the rate of over one knot an hour, as was generally the case, and on one occasion as much as 1¼ knots. The men in the boat could not repress exclamations of surprise, for it really appeared as if some monster of the deep had hold of the weight below and was walking off with it."

I have no doubt that in the Arabian Sea, more especially in the Gulf of Aden, a vast complication, or what at first sight may seem a complication, but it is readily a beautifully harmonious system of currents, will be discovered, and that the officers in charge of the deep sea sounding telegraphic survey, have within their reach a series of discoveries, of the greatest value and importance. To achieve these, they ought not only to be provided beforehand with instruments, but they ought to be carefully trained in their use ; exercised for weeks off the shores of Bombay, while the other preparations for the expedition are in progress. Besides those just adverted to, there are two points demanding especial attention. I shall presently have occasion to lay before you, a large collection of tables of the temperature of the Arabian and Red Sea, taken ten or twelve feet under the surface, with which I have been supplied by Mr. Ritchie, and of its specific gravity and saltness, from some excellent experiments by Dr. Giraud. It will be seen from these, that the Red Sea is saltest in the Gulf of Suez, that it gradually becomes less and less salt, till just east of the meridian of Socotra, when its saltness once more increases on to Bombay. Again, its heat is greatest in the active volcanic region betwixt Jebel Teer and the Straits, where for three or four hundred miles, it is generally above 90° twelve feet under the surface, occasionally rising to the enormous elevation of 95°, sinking again immediately, by nearly ten degrees, when the Strait is passed. The mean temperature of Aden is a little above 80°, its maximum about 96°, but then, some of the deep wells there, rise, doubtless from volcanic causes, to a heat of 92°. As 95° greatly surpasses the mean temperature even of the desert of Sahara, it looks as if this was connected with the volcanic action beneath, a fact to be determined by taking temperatures at great depths. We have no thermometers suitable for this in Bombay—supplies from home, such as those that have been employed in the Atlantic, will be required. If the heat comes from below, we shall then find a highly concentrated brine, or probably masses of solid salt near the bottom. The temperature, as just stated, sinks down almost immediately on

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passing the Straits. It rises again at Aden, a circumstance which is probably due to the shallowness of the sea in the vicenage of the shore. When descending as the Gulf opens up, it once more rises in the open sea under the meridian of Socotra, where the gravity is least, descending again as we near Bombay. The region in the Arabian Sea where the heat is greatest, and the gravity least, is the squally space south of Kooria Mooria bay, where we are most accustomed to meet in with those discolored and luminous tracts of ocean, which have lately received so much notice. I state these things, it must be remembered, as conclusions from a very limited number of facts,—rather as probabilities to be enquired into, than things well established. The actual analysis of sea water is a very troublesome operation, and might, I think, be obviated by the use of the hydrometer,—that now employed on board the steamers being, in my opinion, faulty. Hydrometric experiments are always referred to a temperature of 60°—a very convenient one for Northern Europe, but requiring in these latitudes a tabular correction, which it would be convenient to avoid. I would have all hydrometers meant for sea service cut for a temperature of 96°, a degree higher than the extreme heat of the ocean, the blood heat of the human body. It is very troublesome to cool down water to 60°, and unless this is done, we must make the correction on board ship, and especially on board a steamer. it can be raised to any thing that is desired. On the one side of the scale, the specific gravity should be given—on the other the quantity of salt is indicated, and the observer will thus be able to give all the facts we require at once. A very simple set of tables would reduce the gravity from 95° to 60° when we come to edit for publication. On the table is a collection of hydrometers, and other intruments prepared for these ends many years ago, but which leisure has never permitted me to employ beyound the field of house experiments. The best form of hydrometer, for very refined investigations, is the one I hold in my hand with glass bulbs and a metallic stem. I find glass when drawn out to the fineness required, is so liable to accident, as to need a nicety of packing and delicacy of handing scarcely to be looked for at sea, otherwise a homogeneous material would be preferred.

This having closed the business part of the proceedings, a paper was then read by Dr. Buist on the "Physical Geography of the Red Sea." See *Papers*.

At the conclusion, a very interesting discussion, in which Captain Barker and Mr. Kennelly chiefly shared, took place.

Dr. Buist said that what he had read was merely a compilation, and that with the exception of the geology and meteorology, and some theoretical views of his own, he was entirely indebted to Captain Barker and the other distinguished men, who had conducted the Red Sea survey; and whose only fault had been, that they had not given to the world more of the important information that they had collected. The discussions in reference to the Red Sea took their origin from a communication of Captain Barker, on an eruption amongst the Zebayer islands, he had witnessed in August 1846;

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and as he was now amongst them, it was hoped that the Society would be favoured with the results of his investigations at greater length than they had hitherto been given.

The discussion promised to be productive, and of so much interest, that it was resolved to adjourn it till next meeting, when a paper on the geology of the country round Suez, and of the desert generally, with some references to the topography of the Exodus, would be read. In all likelihood the Red Sea discussion would occupy the entire time of the meeting, when the other paper might be postponed.

The meeting was then adjourned.

At the Ordinary Monthly Meeting of the Geographical Society held on Thursday, the 23rd instant, W.E. Frere, Esq. Vice-President, in the Chair, the following gentlemen were proposed and elected Members :—Lieutenant Montmorency 27th N. I.; and Mr. Bentley, Mint. The following letter from Captain Burton was laid before the meeting. The various references contained in it were made at the suggestion of the Committee of the Society in the correspondence with Captain Burton, and with Government in December 1856 :—

SIR,—I have the honor to acknowledge receipt of your official letter dated the 8th December 1856, conveying to me, by order of the Geographical Society of Bombay, certain suggestions regarding the expedition into Eastern intertropical Africa, which I have been appointed to lead, and to express my gratitude for their valuable instructions and recommendations.

During my last preparatory journey from Mambater, on the Panjan river and thence by land to Fuga, the capital of an interesting mountain district —Usambara—I left at Zanzibar for comparison a barometer in charge of Mr. Frost, Medical Officer to the Consulate, the instrument (by Adie) obligingly lent to me by the Secretary of the Bombay Geographical Society. It would have done scant service during a coasting voyage, and on a rough mountain tour, so delicate an instrument would certainly have come to grief. I took with me four thermometers by Newman, of which one, Boiling Point Thermometer, was rendered useless by the mercury getting in to the upper bulb, consequent upon expansion of air carelessly left in it by the manufacturer. I have now in all four strong Nutt's Thermometers, in good condition, and two Boiling Point ditto, one used by Captain William Smyth, R. N., in crossing the borders, and kindly given to us by Colonel Hammerton. These, even should the "Adie" be broken, and the instrument recommended by the Medical Board Bombay not arive in time, will suffice to determine with tolerable accuracy the altitude of the Unyamisi Lakes. As regards sympisometers, they are found by the long experience of Naval officers, and the accurate hourly observations of a staff of recorders, to be use less by reason of their extreme sensitiveness on this coast within 6° or 8° N. and S. of the Line. This however might not be the case on land.

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For a reference point of known pressure, I am happy to say we can now confidently apply to Zanzibar. Mr. Apothecary Frost, an able and accurate observer, has during the last ten months filled up Meteorological tables with the Barometer,—probably the same instrument sent by the Bombay Geographical Society in 1847,—with Thermometer attached and unattached, wet and dry bulb, evaporating dish, and with the rain gauge. As the Society seems to take an interest in these observations, I have the honor to transmit copies with which Mr. Frost has obliged me.*

I now proceed to answer your letter paragraph by paragraph. (*vide ant.* p.p. xxxi xxxii)

For enquiries into the hydrology of the region which we purpose exploring, I shall be careful to provide myself with a dish and a gauge. The professionally learned however must not be exacting in their demands for observation. These African explorations present peculiar difficulties. An expedition into the Eastern Interior is a small campaign, in which the traveller is beset by all the troubles, hardships, and perils of savage warfare. He must despair of studying "infusoria," unless at least he has nothing else to do.

The Missionaries and all acquainted with the country have wondered at our using instruments at Usambara:—the dazzle of a sextant makes every man thirst for your blood. The climate also is hostile to the traveller in more ways than one. Captain Spike, my well tried and energetic companion, has twice suffered severely from sickness—jungle fever and catarrh, —in consequence of exposure to heat whilst taking observations. The simplest geographical operations become at times impossible. During our two days and two nights at Fuja, a dense pall of clouds overhung the sky, the rains had set in though the half of February had not elapsed; we never saw the sun, and we could not find even a star till we had descended the hills. In these regions the traveller's chief study must be to make things easy, to take all easy, and do only what is easy. I doubt the route crossing any great mountain ridge as you suppose: it leads, say the Arabs, with a steady rise and an occasional ascent, between the coast and lake. As regards our altitudes on the way, we can boil Thermometers and register the Barometer;—for objects on the line of march we must depend upon compass bearings, a Pedometer horse-line and vertical angles observed with a large or small sextant. I have the honor to forward a few specimens of the coast formation: but for the sickness which cut short our journey our collection would have been less meagre. The mountain zone, like Zanzibar and its adjacent Islands, is a mass of corallines, often shelley and coated with red, yellow and black argillaceous soils, rendered fertile by decayed animal and vegetable matter. In some places there are distinct sea-beaches rising 100 to 150 feet above the alluvial plain. In others I could find none.

From Mombas to the Panjany river (the tract called in Sawahil "Mri-

* The copies were received but so far from being of the importance assumed they were transparently so inaccurate as to be set aside as of no value whatever.—G. B. *Sec.*

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ma" or the Mountain Region) stretches a broken line of sandstone at some distance from the coast, and varying from 700 to 1200 feet above the sea level. The interior is gneiss, quartz and sandstone, with detached hills of tufas and grey granite : the latter is so micaceous that the Belooch garrison cannot banish their belief that it contains gold. As at Madagascar no limestone appeared, and the result of enquiry is a doubt of its existence. I inspected many wells and excavations upon the coast, and rarely saw either blue clay or tree roots underlying the gravel. The habitat of the Cocoanut is chiefly the Coralline coast, but it extends along the Panjany river, and bears fruit at least 30 miles from the sea ; wherever it is found at any distance from the main stream the natives judge water to be near.

The ripe Copal (called Gum Animi in the London market) is the most interesting production of Eastern Africa. This semi-fossil is not generally "washed out of streams and torrents," but dug up especially during the rains by the Sawahili of the coast and the savages of the interior. There is, however, a kind of gum called by the natives—who deeming it the Egesta of whales, know no use for it—"Damar." Found upon the sea, especially about Cape Delgado, it floats, whereas copal sinks in water : it may be unripe gum washed from the shore during the S.W. monsoon. The whole of this coast produces the real copal of commerce in different degrees of excellence. Specimens have been brought to Zanzibar from Brava and Magdishu (Magadoxo). Small quantities are found in the Rabai hills behind Mombas, and the tree grows in the Jungle-patches which stud the range. From Panjany southwards for 80 miles it is plentiful, at distances varying from three hours' march to two days' journey from the coast. It would be impossible for us "to trace the position and circumstances of the extinct forest, of which it now constitutes the principal remains." Such an investigation would require at least two months' voyaging along and dwelling upon the fatal sea board. In most places, I am told, there is now no sign of a tree.

Of Gum Copal these regions supply two great varieties :

1. Raw, popularly called "Jackass Copal," is, I venture to opine, the gum which, exuding from the trunk or branches of the tree when injured by elephant or man, fall to the ground, and either infiltrated, or was covered by successive layers of soil. Like a common resin it is softened by spirit, and becomes viscid in the solution used for washing ripe copal. This variety is exported in considerable quantities from Zanzibar to China, where, it is said, the people have discovered and retained to themselves the secret of working it. At Bombay and Surat, it is made into an inferior varnish for carriages and palanquins.

2. The ripe or true copal—a semi-fossil, doubtless the product of forests overthrown by gradual decay, by the upheaval of the coast, or by some violent agency of the elements. This is proved by the fact, that pieces of the gum are met with embedded in wood, which crumbles to dust under the touch, and by its "goon-skin," which is the impress of sand or gravel.

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There are many varieties of colour, caused probably by the embedding strata, the clearest and most transparent fetches the highest price; then follow the numerous and almost imperceptible gradations of light amber, lemon and dark yellow, red and tufas. I have seen a specimen of tender green. Sometimes the gum, like Sicilian amber, contains drops of water, bees, tics, flies and other insects, delicately and completely preserved, and disproving a remote antiquity.

Without entering further into theory, I will simply describe two visits which I made to the Copal-diggings. On the 10th May, I rode out from the Town of Zanzibar upon the Mony road. One mile east of the town lies a low sandy plain covered with sedgy grass, and pitted with holes two or three feet deep, from which copal had been dug. The place is about a mile from the shore, apparently but a few feet above high-watermark, and bounded landwards by a sandy nullah. Passing the palace of Mtony, some one hundred yards, I was shewn a torrent bed, where during the rains copal is said to be brought down and picked up by slaves. Thence turning towards the interior we rode up the rising ground, to judge by the eye, about one hundred feet above the level of the sea, for a mile and a half into an estate, belonging to the prince, and called Ruzah. Here were many traces of copal diggings. The soil is a dark vegetable mould varying from a foot to a foot and a half in depth, passed upon blue clay, the raised sea beach. This clay becomes exceedingly fat and adhesive, clogging the bar the deeper it is excavated; it is mixed throughout with fibres, said by the negroes to be roots of the Cocoanut tree half decayed and of bright red: blood colored bits of earth also variegated the faint blue color, and at a depth of about two feet and a half, water began to exude from the greasy walls of the hole. The copal is here found in the vegetable soil overlaying the blue clay.

On the 13th May I started from Saadan, a haven on the mainland, opposite Zanzibar, in company with the Akida-ao, or Mucuddum of the copal diggers. Passing over an alluvial plain, covered with rank vegetations, Acacias, thorns and spear grass, after walking three miles I was shown the copal tree. It is growing in a thicket upon a flat covered with toddy and fan palms, but no cocos; it stands about thirty feet high, and measures in girth three feet. Gum exuded from the bark, and in securing the specimen of the wood herewith forwarded, we were pitilessly assailed by a large ginger-colored and semi-transparent ant whose every bite drew blood. The copal tree is rare on this part of the coast: within the space of several hundred yards I saw two only.

Another mile brought us to a distinctly defined sea beach rising about 150 feet in a swell from the plain, marked by a regular line of quartz and quartzose pebbles and crowned with luxuriant thickets. The soil is sandy, and here as on the flat below are frequent traces of the copal digger. Our guide was induced to cut a stick to sharpen it, and to scrape out the earth which produced several bits of gum. One of the slaves dug a pit about three feet

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deep; the color of the band became redder as he went lower, crimson fibrous matter appeared, and presently the ground seemed to be half copal, half sand. He assured me that there is no subsoil but this red sand, and that his people never dig deeper than a man's waist.

The whole of this land from Panjany to Mboamaji may be called the copal coast: it affords an apparently endless supply of the gum. Copal is obtained by scraping the sand, even in places washed over by high tides and often when digging holes, to fix the poles of houses, the people come upon it. That of Saadan is poor compared with the produce of Wande and the Southern harbour. On the mainland it costs half price of what is paid upon this Island, and the lazy inhabitants of the villages can never be induced to dig whilst they have handful of food remaining.

The copal tree (Valeria Indica ? or Hymencea Vermicosa?) is still found in the Island and on the mainland of Zanzibar. It is not as was supposed a small and shrubby thorn nine feet high: from its towering stem canoes sixty feet long have been made, and a single trunk has sufficed for the kelson of a brig. The green wood is gummy; whole flakes at times adhering to the saw. When dried it is well veined of a light tint, and has been used for the pannels of doors: when oiled and polished it darkens to a yellowish-brown. Its small branches freshly cut make good and pliant sticks for chastisement.

I have the honor to forward the best specimens procurable of the superficial soils, in which the gum is chiefly found, the underlying blue clay, the reddy earth that is found mixed with the latter, a piece of copal, branch and leaves, and a bit of the gum here called "Damar." Unfortunately the copal tree was not in flower or fruit: the people assured me that it bears a berry not unlike a grain of Indian Corn.

The merchants of Zanzibar (mostly Germans and Americans) are not likely to throw away an ounce of serviceable copal, and they have consulted the ablest European Technologists upon the subject of preparing it to the best advantage. Supply certainly no longer meets demand, but that golden rule of political economy, full of exceptions in civilised regions, in these latitudes becomes a sad fallacy. There is an inexhaustable supply upon the coast of East Africa, but "hands" are wanted. When there is little rain and the ground is hard, the lazy savage will not dig. Moreover "Kizkazy copal"—that excavated in the N. E. or dry monsoon—annoys merchants by the difficulty of washing off the hard sand which adheres to its surface. Whenever upon the coast there is either a blood feud—and these are a legionary host—or a drought, or a famine, or a pestilence, the people strike work and dollars are offered in vain.

I must leave, Sir, to your ingenuity the task of remedying these evils. European labourers cannot be employed, the climate of East Africa, as has been abundantly proved is not less injurious to our constitutions than the worst parts of the Western Coast. Indian coolies, the only procurable hands, would fear to face the wild men, some of whom I believe to be

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inveterate canibals. If they did summon courage they would lose their lives, and justly enough, for trespassing upon other people's property. A large gang (say 500) of good fierce negroes from Kilva (Quiboa) and the southern parts, might be taught to use a proper mattock instead of the child's plaything now employed, and each man would doubtless procure twelve or fifteen lbs. per diem; but the Imaum's Government would probably object, as a late treaty enables it to do. The Lawahili Mtua Mkuba or muccadum of the copal diggers would require propitiation, and to prevent the labourers running away, it would be necessary to enter into arrangements with all the chiefs of tribes, villages, and harbours. It is to be feared that such an operation commercially speaking would not pay. Willingly therefore as I would wish that highest of meed, the gratitude of my fellow countrymen, by reducing the price of carriage-varnish, I must fairly confess it to be beyond my powers. The sole remedy for the manifold diseases of this Bona Terra with its Malaguns is time:—perhaps an occasional East African expedition might be administered to advantage.

We have, I am happy to say, shaken off the miasmatic fever of the coast, and are ready to set out again when the rains shew any signs of abating. Dr. Steinhauser has not yet joined us, but we are in hourly hopes of the welcome event: his presence will be no small comfort in a sickly climate, and where we must expect to suffer from the hardships, exposure, and various incidents of African exploration.*

RICHARD F. BURTON, Bombay Army,
Commander E. A. Expedition.

Dr. BUIST then proceeded to give some addition to his previous paper on Geography of the Red Sea. This was followed by some admirable remarks

* The following extract from a letter from Major Rigby, since September last resident at Zanzibar, contains much that is interesting bearing on the points on which Capt. Burton touches. It is added as a contribution, short though it be, of very great value on the statistics of the Commerce and Commercial Capabilities of Zanzibar. It is most singular certainly that England should only possess one-seventh the Commerce of France, one-fifth that of America, one-fourth that of Hamburg, with a port within a week of us, none of the countries just named having a possession in the eastern seas at all.

ZANZIBAR, 25*th August* 1858.—"We left Bombay on the 20th June and had for the first 8 or 9 days rough weather with frequent squalls, but we ran out of the S.W. monsoon in about 4° north, and then had lovely, cool, steady weather all the way to the Seychelles. We got to Mahi in 18 days, passing to the north of the Chagos Archipelago. Three or 4 years ago the *Clive* went to the Seychelles in the same month and was 30 days, because she went down as far as 10° south, 5° more than we did. There is an idea amongst naval men in Bombay that you must go down 10° south to make the passage to Zanzibar or the Seychelles at this season, and it is a great mistake. There is also another idea, that it is impossible to make the passage from Aden to Zanzibar during the S.W. Monsoon. Whenever I enquired whether I could come here *via* Aden I was told it was impossi-

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by Captain Baker, when a discussion of some length arose, in which various members shared.

Dr. Buist on exhibiting the mass of Iron formerly supposed a meteor,

ble; that a vessel would have to cross almost to Bombay before she could make any southing. Now I find that American ships come here regularly every month during the South-West Monsoon, and one arrived lately which made the passage in 24 days. The Captain tells me he ran down to the Equator in 9 days and had fine calm weather; he only went as far as 1° South and 63 E. L and before steering for this. It is a pity that so little is known about the navigation to this place, because the French, Americans and Germans are monopolizing the valuable and fast increasing trade here to the total exclusion of the English, as you will perceive from the following statements of arrivals of ships here:—

1852	74	Vessels arrived here	1855	66	(Trade affected by the
1853	76				Russian war)
1854	81		1856	89	

And in this last year they belonged to the following States:—

3	English	1517	Tons	2	Spanish	460	Tons.
20	Hamburg	5438	do.	1	Prussian	600	do.
24	American	7215	do.	1	Danish	450	do.
23	French	10979	do.				
12	Arab	3938	do.	89	Ships	31,127	Tons.
3	Portuguese	930	do.				

And so little is thought about this place in Bombay that the Marine Office had no charts of the Channel, although every foreign vessel coming here has excellent charts of it; and it seemed somewhat humiliating to find that the Commander of one of the Hon'ble Company's ships of war was obliged to borrow charts from merchant ships here, because his vessel had been sent to sea without them: and now, look at the result. We made the southern point of the island of Zanzibar in 7 days after leaving Mahi. We came up the channel with a fair wind and were within 15 miles of the harbour; but it was near sunset, we could not distinguish the coral reefs, not a soul on board knew the place, the vessel had no chart of the channel, so we stood out to the south for the night. At daylight, we found the current had set us out to leeward of the island. We beat against the current for two days, but in vain. We got set to the north close to the island of Pemba. Had the Captain had any directions for making this harbour, we might easily have come in to the north end of the island, but having no proper charts, he thought it was a great risk to try it; so we stood out to sea to the east, and did not get in for six more days, before which the crew were on half allowance of water; and had we missed the point again must have run back to Bombay, for the last flour had been issued, and there was very little biscuit or fuel left. The night before we got in we were set 54 miles to the north by the current. In these parts the currents are very extraordinary. You remember the 'St. Abbs' was wrecked about two years ago on the island of Juan de Nova to the east of Madagascar. Well, part of her cargo and part of the wreck have been washed up at Brava on the east coast of Africa, in about 1° North. Many articles, musical instruments, surveying instruments, billiard balls, &c., have been sold here, which were recovered there, and I understand a great many articles were sold to buggalows. I remember the 'St. Abbs' had 3 or 4 billiard tables on board. This place has never been surveyed since Captain Owen was here, in 1824 and 25, and it is now known his survey is very incorrect, and Horsburgh is very indistinct. It is a pity it is not resurveyed, for there

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stated that on analysation by Dr. Giraud, none of the meteoric metals save the iron was found contained in it. The idea of its extra-telluric origin must, therefore, be abandoned. It contained a large quantity of arsenic and some antimony, and was pronounced by all the chemists and metallur-

are many shoals in the south part of the channel not laid down in the charts. This is a lovely island, of unbounded fertility; the mango and other trees grow to an enormous size, oranges grow in profusion everywhere, and pine-apples of large size and good flavour grow wild all over the island. The Arabs find the clove plantations so profitable, that they are now growing cloves to the neglect of all other produce. There is not much field for a Geologist here, for there is scarcely a pebble to be found anywhere. The soil is a rich vegetable mould formed by decayed plants on a bed of coral; but for a Botanist this would be a paradise, many rare and valuable plants grow here wild: the Sarsaparilla, the Copal tree, spices of all sorts, sugar-cane of immense size, and rice, the finest I have ever seen. The common Indian Dholl plant is here a good-sized tree. The climate at present is delightful, much cooler than it ever is at Bombay, and I believe it is never very hot here, and some of the merchants who have been here some years tell me, the climate is healthy if people are moderately careful. It is dangerous for Europeans to sleep in the interior, or in any of the garden houses because the vegetation is so exceedingly rich; but the town is healthy. I find in the Meteorological Tables for Zanzibar, published in 1850 by the Observatory at Bombay it is stated, "it is evident that but few European constitutions could exist in the climate of Zanzibar." Now, when one sees Europeans and Americans who have lived here for years and tell you they never had a day's sickness, it is evident that these remarks are quite erroneous, and they do harm by frightening English merchants from coming here. I heard all sorts of absurd stories about this place in Bombay; one said, oh! it is so frightfully hot that no European could sleep a single night on shore without danger; another three generations of European settlers had died during the last thirty years. Now, what do I find; the Thermometer never rises above 87°; the nights are always quite cool, I always put on flannel if I go on the roof of my house after sunset; I find the merchants living in comfort if not luxury. English and French ships of war are constantly coming here for supplies and Zanzibar is rapidly becoming the emporium of all the trade of Eastern Africa, and old John Bull is so gulled with accounts of the bad climate, &c., that he won't cut in for a slice of it. Another gross error in the climatology published is, that there is no dew here, whereas one of the prettiest features in a morning's walk through the woods is, to see the heavy dewdrops on every branch.

News arrived a few days ago from the East African Expedition—not from Burton or Speke, but an Arabian letter from the chief Arab with them; it was dated "Bunder Ujij" 26th March, and stated that they arrived there on the 14th February, and had been detained there up to the date of writing for want of the means of crossing the inland sea or Lake; that they had a pleasant and safe journey up, and the gentlemen were quite well. Bunder Ujij is known to be a town on the great Lake, and in the map compiled from native descriptions by the German Missionaries it is called Ujigo. Mr. Rebbman, who has lived 14 years on the coast near Mombass, says, the people are quite inoffensive, and that the road Burton has gone is so safe that a lady might travel it without risk. They have a guard of the Sultan's soldiers from here, and a large amount of baggage. The French are carrying on an immense slave trade all along the East Coast of Africa; large vessels are being sent out from France to engage in it: they call it the Engagé trade. One man at Marseilles has contracted to convey 2,500 ne-

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gists of the presidency the most extraordinary specimen of cast Iron ever seen by them.

Zanzibar, May 25th, 1857.

The Ordinary Monthly Meeting of the Geographical Society took place on Thursday, the 18th instant, Captain Wellesley, Commander-in-Chief of the Indian Navy, the President, in the chair.

Mr. Bently and Lieutenant Montmorency were proposed for election. This was the only business before the meeting.

Dr. Buist then proceeded to give an account of the Geology of the Rock of Gibraltar. See paper p. 46. A suite of eight drawings, taken from on board ship, in various voyages round the Rock, from the anchorage or from the shore with numerous sections, charts, and diagrams representing

groes to Bourbon in two years. There are two French ships of war here now, *L' Eglie* and *Genie* which have come to induce the Sultan to give his consent to the export of negroes from his dominions to Bourbon, but he has given a positive refusal. There is a large French ship here now full of slaves, they all have a board round the neck with a number on it. The French settlements Mayotta and Noss Bey, are mere slave depots. The slaves are taken there in native boats from all parts of the Mosambique, and then shipped to Bourbon as engaged labourers. The Portuguese Gov. General lately caught a French ship taking slaves from the Portuguese territory in the Mosambique, and condemned the ship, and the Captain has been sentenced to 10 years' imprisonment. The French are very wroth, and a ship of war was sent there from Bourbon to demand his release, but the Portuguese refused to give him up. The present Sultan here, Said Majid, is a most amiable, liberal-minded man, and is most highly spoken of by all the Europeans and natives."

28th Agust.—I have opened my letter again to tell you of a splendid meteor which was seen here yesterday evening. At 7 P. M. about N. E. and 40 degrees above the horizon, there was a very brilliant light, and a meteor shot from it and disappeared below the horizon: but the light remained a clear bright streak to the naked eye, appearing about 2 feet in length for about 20 minutes, when it gradually paled. The stars were shining, and whilst it was visible it was as brilliant as the large stars. I have told you of it as it may have been seen in other parts. I am told that meteors are sometimes very beautiful here; that a while ago one shaped like tulip, and which stretched across several degrees, was visible for some time. I am told by the merchants, during the N. E. monsoon a great deal of fine regularly cut teak timber is washed ashore on the African Coast near Brava: it is much prized, and some of the merchants have sent to their agents at Brava to buy as much as they can of it next season. Where can this come from? They say here it is drifted across from the coast of India. Can it be washed out of any of the rivers in Burmah or Siam? I don't think there is any teak in Madagascar, or any place to the south of this. It is a very curious circumstance, and I'll make more enquiries about it. I have sent some specimens of a very curious vegetable growing in the Governor's Garden at Mosambique. It is a sort of potatoe growing on a tree, they are of every variety of shape, a dark green colour, inside very like the common potatoe. The tree grows in the interior of Africa, and is thought a curiosity at the Mosambique.

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Gibraltar in all its aspects were exhibited ; while a large and varied collection of specimens completed the illustrations.

The Annual Meeting of the Geographical Society for 1858 was held in the Rooms of the Society 20th May.

Present.—Commodore G. G. Wellesley, *President*, in the chair. W. E. Frere, Esq. T. H. Bent'y, Esq., Ali Mahomed Khan, Esq. and Dr. Geo. Buist, Secretary.

The minutes of last annual meeting having been read and confirmed Capt. Ahmed bin Ali Khan was elected a member of the Society.

Presents to the Library.—Selections from the Records of the Bengal Government, No. XXVII.

Dodabetta Meteorological Observations from 1851 to 1855.

The Secretary stated, that during the past year five new members had been added to the roll viz:—Commodore Wellesley, Dr. Leith, Lieut. Montmorency, Mr. T. H. Bently, Capt. Ahmed bin Ali Khan.

The following Members had returned from Europe since last Anniversary Meeting:—Henry Young, Esq. C. S., A. Robestson, Esq. C. S., R. Willis, Esq., J. M. Erskine, Esq. C. S., and Dr. Morehead.

The following have retired from India:—Admiral Sir H. Leeke.

On the retirement of Sir Henry Leeke in September, Commodore Wellesley was elected President of the Society.

In the course of the year papers had been read on the following subjects:—

On the Physical Geography of the Red Sea, by Dr Buist; with a supplementary paper by Captain Barker:—On the Geology of Lower Egypt, especially of that portion surrounding the Gulf of Suez, Dr Buist:—On the Geology of the Rock of Gibraltar, Dr Buist.

The state of the Society's Instruments and other apparatus remained nearly as at last annual meeting.

The following office bearers were elected for the year 1858-59:—

Vice Presidents:—The Hon'ble A. Malet, W. E. Frere, Esq., H. L. Anderson, Esq.

General Committee of Management.

Resident Members of Committee:—Dr Bawoo Dajee; R. S. Sinclair L.L.D. J. J. Berkley, Esq.; W. F. Hunter, Esq., Cursetjee Jamsetjee, Esq; Dr. J. W. Winchester; Narrayen Dinnanathjee Esq.; John Ritchie, Esq; Dr. E. Impey; Capt. Barker; T. H. Bently, Esq., Dr. R. Haines.

Non-Resident Members of Committee:—Col. LeGrand Jacob; Com-

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man der A. F. Jones; Dr C. Morehead; P. W. LeGeyt, Esq.; Colonel J. Jacob; Lieut. A. D. Taylor, I. N.; Captain A. B. Kemball.

RECEIPTS.

1857.						
May 1.	To balance in the hand of the Treasurer	Rs.	643	3	7	
	To Secretary	„	47	10	6	690 14 1
	To Government Subscription through the year @ Rs.50 per mensem.					600 0 0
	To Annual Subscriptions of Members					480 0 0
	To Philosophical Instruments sold					22 0 0
	To Society's Transactions sold					2 8 0
	To Interest on Treasurer's Account up to 31st July 1857.					27 0 0
					Rs.	1,822 6 3

DISBURSEMENTS.

1857.						
May 1.	By Cash &c. to Office Establishment					600 0 0
	By Cash paid for contingencies					181 5 4
	By Cash paid to Deputy Post Master for Postage by Cheque					23 0 0
	By Cash paid for Printing and Advertising					223 0 0
1858	By Cash paid to Commission to 31st July 1857.					9 9 0
April 30	By balance in the Treasurer's hand at this date	Rs.	765	9	10	
	By balance with the Secretary		19	13	2	
						785 7 0
					Rs.	1,822 6 3

ASSETS.

Instruments in hand on the 30th April 1858.

4 Sympiesometers @ Rs. 55 each	Rs.	220	0	0
3 Adie's Double Thermometers @ Rs. 13 each	„	39	0	0
Mountain Barometer one large	„	120	0	0
Three Ordinary and 70	„	210	0	0
	Rs.	589	0	0

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TRANSACTIONS

OF THE

BOMBAY GEOGRAPHICAL SOCIETY.

ART. I.—*Physical Geography of the Red Sea.* By DR. GEORGE BUIST, L.L.D. F.R.S. L. and E. &c.

Boundaries.—The Red Sea is one of the most remarkable estuaries on the surface of the globe; separating the N. E. portion of Africa from Arabia for the space of above 1280 miles, it seems at no very remote period to have been connected with the Mediterranean. Opening into the Indian Ocean through the Gulf of Aden, it commences at the Straits of Babelmandeb, lat. 12° 30' N., long 43° 40' E., extending in a north-westerly direction till it terminates in the two Gulfs of Akabá and Suez, the upper extremity of the former being in lat. 29° 36' N., long. 35° 2' E., that of the latter in lat. 30° 2' N., long. 32° 38' E. From the Strait to Suez in a direct line is 1230 miles; the greater strait itself measures in breadth 13 miles, the lesser 1¼ miles; the two together, which constitute the entrance to the sea, 14¼ miles, or including the island of Perim, which separates them, 16¼ miles. Its entire circuit measured round both gulfs is 4020 miles, its area 108,154 miles, and its cubic content probably about 800,000 miles.* Its greatest breadth under the parallel 17° N., that is one-third up the sea, is 192 miles and it narrows pretty uniformly towards both extremities, being 72 miles across at Ras-Mahommed, where the peninsula of Mount Sinai splits its upper extremity into two, and nearly a similar breadth at Gibbel Zugar, under the 14th parallel.

Gulf of Suez.—The Gulf of Suez from its upper extremity to its entrance is 167 miles in length; its greatest width is under 30°; at its mouth it is about 17 miles from shore to shore. Its area in all is about 2000 square miles. Its greatest depth is about 50 fathoms, its average about 22; excluding the shallows at Suez, which occupy from 8 to 10 miles at its upper extremity.

Gulf of Akabá.—The Gulf of Akabá is about one-third the area of that

* The figures representing area, circumference, and content are to be received as approximations merely—especially the circumference; the area will probably be found not very far from truth.

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of Suez, or 800 miles; it is 100 miles in length, 16 across at the widest, and 7 at the strait. It is more than double the depth of its sister gulf, being about 120 fathoms for two-thirds of its length, reaching at one point the depth of 200 fathoms without bottom. Its mean depth altogether is probably not less than 70.

Depth of the Red Sea.—Two-thirds of the area of the Red Sea have never been sounded, and although no sufficient data exist from which to form a judgment of its depth, there is reason to believe it in some parts very great. There are soundings all around its shores from 10 to 20 miles out from Judda, in lat. 21° 30', to the approach of the volcanic region in lat. 17°, and frequent cross soundings have been obtained from this southward to the strait. From 21° to 27° 30', or for nearly 400 miles in length, there is a space from 50 to 70 miles in breadth, or an area of about 20,000 miles, that seems never to have been sounded; and this part has not been examined since the original survey was made 20 years ago. Being free from islands, reefs, and shoals, it occasioned no alarm to the navigators, and the surveyor had no time to devote to mere questions of physical geography. The greatest depth that seems ever to have been tried is 400 fathoms, lat. 25° 20', at which no bottom could be found; and there appears to be a chasm from 5 to 10 miles wide down the centre of the sea, varying from 150 to 250 fathoms with abrupt and precipitous sides. The average depth of the central region of the sea to an extent of about 40 miles or so may probably be about 300 fathoms; the average depth of the whole sea probably falls short of 70. A reef or shallow runs across from Mocha, lat. 13° 30, to the African shore; it has been very carefully sounded all along; it affords an average depth of from 25 to 30 fathoms; its greatest depth being 40, near mid-channel. From this the sea deepens again to 125 fathoms* as it approaches the strait. The great strait, as already mentioned, is 16 miles across; its average depth is about 80 fathoms, its greatest 125; and for a breadth of nearly 6 miles in mid-channel the depth exceeds 100 fathoms. The narrow channel being that which vessels from Aden almost always prefer in ascending the Red Sea, varies from 12 to 17 fathoms in depth, but there is 30 feet of water up to both shores with a fine sandy bottom, so that navigators feel no apprehension in traversing it at any hour. The Gulf of Aden, which continues the communication from the Straits to the Arabian Sea, is a funnel shaped estuary above 900 miles in length and nearly 200 across from the N. W. point of Africa to the Arabian shore. Its general characteristics are similar to those of the lower part of the Red Sea—it is remarkable for the violence of its currents, which will be noticed afterwards, and for the depth of its central channel and shallowness of its shores.

The Tides at Suez are about 5 feet at neap and 7 at spring. The rise and fall at Ras-Mahommed is about 5 feet—high water spring tides at 6 o'clock. The direction of the wind makes a difference of about 4 feet in the depth of

* The depths are taken from the chart, but the greater part of the soundings are marked as having "no bottom," so the actual depths are certainly beyond this—how much we know not.

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the water near Suez: the banks which are left dry by the N. wind are well covered with a breeze from the S. We know little of the tides over the rest of the sea. At Aden, 80 miles without the strait, where continuous observations have been taken by gauge for three years, the tides rise 4 feet at neaps, and nearly 8 at springs; high-water occurring at 1·30; the sweep of the tides, as well as the hour of high-water, being remarkably irregular. The Red Sea probably derives its name from large portions of it, as well as of the Arabian Sea, being covered with patches, from a few yards to some miles square, of a blood-red colour, derived from a species of vegetable or animalcule particularly abundant in the spring months, and which dyes the upper waters of the most intensely blood-red hue that can be conceived.* There is nothing else about the sea that is red, and a considerable expanse of this, encountered by an early navigator who had not met with any similar phenomenon elsewhere, would seem warrant enough for its name.

Islands.—Though islands are numerous along both shores of the Red Sea, they are for the most part of inconsiderable size, and they have been included in the measurement of the area: their structure will come to be spoken of along with that of the rocks on the opposite shores.

Appearance and Saltness of its Waters.—As the Red Sea is entirely surrounded by a hard, sandy, or rocky shore, without a rivulet, and scarcely a drop of rain falling into it from year to year, its waters are remarkable for their transparency and purity, even over a long expanse of shallows. Where the sea is deep and distant from the land, its colour is of the most intense blue, changing from greenish-blue to bluish-green, green, and light green, as the coral reefs approach the surface—the dead corals themselves being mostly white, the live ones greenish. It was long supposed to be considerably salter than the general ocean, a supposition now proved to be partially unsound. In 1837 Dr. Malcolmson found the water off Cossir of specific gravity 1·035, indicating a degree of saltness greater than that at Suez but not so great as that of many parts of the Atlantic. The water at Mocha and Camran hardly at all differs from that of the outer sea. In 1848 Mr. Morris, engineer, obtained for me specimens of the water from seven different stations, nearly equidistant from each other all the way down: they were examined by Dr. Giraud, Professor of Chemistry at Bombay, and the following were the results:—

		Lat.	Long.	Sp. gr.	Saline Contents in 1000 parts.
		° '	° '		
No. 1	Sea at Suez ...	29 40	35 2	1·027	41·0
2.	Gulf of Suez . .	27 49	33 44	1·026	40 0
3	Off Cossir	24 29	36 0	1·024	39·2
4.	Off Jedda	20 55	38 18	1·026	40·5
5.	Off Hali	18 43	40 3	1·024	39·8
6.	Off Hodida	14 34	42 43	1·024	39·9
7.	Below the Strait ..	12 39	44 45	1·023	39·2

* See Transactions of Bombay Geographical Society, previous number; also Dr. Carter's paper on the Colouring Matter of the Sea, Transactions of the Bombay Branch of the Royal Asiatic Society 1858.

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Dr. Giraud gives the following note of the saltness of the sea from a variety of other localities. From this it will be seen that the Mediterranean at Marseilles is of the same saltness as the Red Sea at Suez, while the Atlantic in the latitude of Canaries is $\frac{1}{100}$ more salt.

	Grs.	
Baltic	20.0	in 1000
Frith of Forth	30.0	,,
Boulogne	32.0	,,
Havre	36.0	,,
Bayonne	38.0	,,
Marseilles	41.0	,,
Atlantic, Canaries	44.0*	,,

The following is from Dr. Lyon Playfair and Liebig's Report 1852 Sea Water.

					Grs. 1.000
Port of Callao	A	12° 5 S	77 14W.	March	Sp. Gr· 32.752
Algodon Bar	B	22 6 S	70 16W.		1.0278 36.773
Dead Sea	C	25 11 S	93 24W.	March	1.0284 35.233
Cape Horn. same Spot	D				1.0260 34.708
Near Cape Horn	E	56 32 S	68 47W.	April	34.763
Atlantic	F	20 45 S	29 27W.	May	1.0244 32.583
Same	G	00 47	30 20	22	1.0275 35.695
Same	H	20 54 N.	40 44W.	June 4	24.746
Same	I	41 19W.	36 28W.		1.0287 38.422
North Sea	K	51 9 N.	3 34W.	July	1.0264 34.083

The following are from specimens of Water taken by Lieut. Adams of the H. C. S. Victoria betwixt Suez and Bombay, October 1854. They were very carefully analized by Dr. Giraud.

140 Miles from anchorage		Lat. N.	Long. E.	Sp. Gr.	gives in 1000	Date.
Gulf of Suez near bottom	1	28 25 N.	38 15	1·0803	42.6	
Red Sea	2	25 28	35 44	1·0304	42.9	
Yemboo	3	22 25	37 24	1·0297	41.5	
Jedda	4	19 14	39 14	1·0288	40 7	
Hodida	5	16 14	41 25	1·0288	40.0	
Mocha	6	16 00	43 20	1·0280	39.2	
Gulf of Aden	7	12 57	46 59	1·0270	89.2	
	8	13 29	47 44	1·0270	37.6	
Open Sea N. off Socotra	9	14 18	52 30	1·0269	35.8	
	10	15 35	55 50	1·0267	36 8	
Opposite entrance P. Gulf	11	16 40	59 33	1·0265	37.5	
East of Persian Gulf	12	17 30	63 11	1·0270	37.4	
Meridian of Kurrachee	13	18 04	66 49	1·0279	37.4	
100 Miles off Bombay	14	18 37	70 24	1 0270	37.8	

These experiments were made on water taken from 10 feet below the surface of the sea. We are ignorant of the character of the water in its depth, but have no reason to suppose it to differ materially from that at the surface.

From the specimens collected by Captain Adams, like those formerly taken by Mr. Morris and carefully analysed by Dr. Giraud, we have the following results. The water of the Gulf of Suez contains from 2 to 3 grains per

* Most likely where the Salt under Current of the Mediterranean rises to the surface.

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1,000 more than that of the Sea of Mocha—and this again is salter by 2 or 3 in the 1,000 than that of the outer ocean. Passing the Straits, we find the same saltness to a certain extent to continue till we reach Aden. It has been 42 grains in the thousand in the Gulf of Suez, 40 in the upper and 39 in the lower part of the Sea, but this last continues for a hundred miles below the Strait. As the Gulf opens out, and the waters of the Arabian Sea enter freely, it suddenly falls to 37 off Socotra, and further out in Latitude 14-18 and longitude 52-30 it descends to 35·8. As the shores of India are approached, the quantity of salt again increases, for one reason perhaps more rapidly than it otherwise would, in being mingled with the saline contents of the Persian Gulf, which like the Red Sea, throws off much more water in vapour than it receives from the rain or the streams entering it, and which may therefore be assumed considerably salter than the outer ocean. When the temperature of the Sea comes to be examined, it will be seen that the water is much warmer compared with the air along shore, than far out and here also the air is drier and the evaporation greater. Though the currents in the Sea, which these things themselves help to produce, tend to commingle the waters together, it takes some time to restore the equilibrium at first disturbed; observation bringing to light the very facts theory led us to look for. Unless where great rivers discharge themselves nearest the land, narrow seas are more salt than the open ocean. Wherever water of extraordinary density makes its appearance,—as for example off the Canaries in the Atlantic, some separate disturbing cause is sure to be discovered close by,—in this case the outward flowing over salt current of the Mediterranean.

Climate and Winds—From the general conformation of its shores, the winds in the Red Sea for the most part blow in the direction of its axis, being for eight months in the year from the N. W., for the remainder from the S. E. The characteristics of the climate of the upper and lower portions of the sea differ, as may be expected, materially from each other, that of the middle portion partaking occasionally of both. The N. E. monsoon, which commences in October and continues till May or June, blows with considerable freshness in February, but is as summer sets in occasionally interrupted almost altogether. On entering the Red Sea it is deflected, and pursues a path almost at right angles to that which it had previously pursued, becoming a south-easterly wind as it rushes up the axis of the sea. Confined in a comparatively narrow compass, it blows with considerable violence, and is stronger towards the Arabian than the Abyssinian shore in the lower part of the sea. It is freshest in the end of October and beginning of February, and is sometimes felt as far up as Suez, so that generally by the time that it gets as high as Judda, lat. 21° 30, it becomes for the most part light and variable. It slackens as it passes the Harnish and Zugar islands under the 14th parallel, where the sea begins to extend in breadth. Further to the northward it softens still more, till it is lost in the languid winds on the coral reefs of the Arabian Coast, or turning to the westward, wanders away out towards the islands of the African shore, until changing

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its course, it returns again into itself. In October and January the weather in the lower part of the sea is thick and hazy, obscuring objects until they are close at hand, and squalls and rain are frequent and heavy. Captain Ellowan states, that in December land and sea breezes were prevalent on the Arabian shore, half way up the Red Sea, with occasional southerly winds; in January it was frequently squally, with thunder, lightning, and some rain in the southward, occasional squalls being experienced in February. On the African coast, in lat. 15°, the prevailing winds in March are westerly, drawing off from the land towards night, from the sea during the day. In April regular land and sea-breezes prevailed, the winds generally from the N., though twice or thrice from the S., and the weather often hazy. In May the wind mostly comes from the land, the sea-breezes becoming light, sand squalls being experienced towards the beginning of June.

When the south-easterly monsoon begins to blow in the north-westerly part of the Indian Ocean, north-westerly winds prevail in the lower half of the Red Sea, where they blow with considerable violence in June and July becoming light and variable in August and September. As the time of their extinction approaches, there are sometimes calms of several days' duration experienced, when the sea-breezes become excessive. On the African shore, sea and land breezes are experienced towards the strait, with northerly winds nearly all the year round. The fine season prevails from August to October, showers, such as they are, are chiefly experienced from November to March. The winds from Suez to Judda are mostly notherly throughout the year, and occasionally blow with considerable violence. From December to April southerly winds are occasionally experienced in the Gulf of Suez, at times freshening into a gale, and blow for several days. Captain Carless tells us, that it is almost always stormy in the Guif of Akabà, the squalls being dangerous and violent where the two gulfs unite. Captain Cruttenden states, that when he visited Senna in July 1836, no rain had fallen, either there or at Mocha, for four years, but that during his stay heavy rains fell for nearly a month. These remarks are all taken from the writings of the officers on the survey, some of which still remain unpublished, and are mostly from the sailing directions of Captain Moresby. We have no regular meteorological observations from any part of the Red Sea higher up than Aden, where the evaporation amounts to about 7 feet annually. Off the peninsula of Sinai, according to the experiments of Captain Carless, it amounts to between 8 and 9 feet, and when the dryness of the desert winds is taken into account, the evaporation over its whole surface will probably be found to fall little short of 8 feet annually and certainly not more than an inch of rain or rain-water is added in the course of the year; the showers, heavy as they are, which occasionally fall on its shores being drunk up by the thirsty sands which cover them all around.

Hail storms of great violence occasionally occur both in the Gulf of Aden and in the Red Sea.

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Capt. Haines in 1836 experienced a hail storm of much force lat. 22 long. 60 off the Persian Gulf.

The following is given from the Log of the Clive Lat. 19.18 Long. 40.03 December 22nd 1842. This was followed a few days afterwards by a violent fall of rain at Aden.

"Tuesday, Dec. 26, 1842.—3 P. M. Dark squally appearances to the eastward with lightning. At daylight still a dark threatening appearance to the N. E., loud peals of thunder with vivid forked lightning, and the wind veering from S. S. E. to N. E. At 10 hard squalls, with heavy rain accompanied by hail, Lat. 18. 19 N. Long. 40.03 E."

There was a violent fall of rain at Aden more than six inches which nearly deluged the Cantonments on the 28th, 29th, 30th. Decr. 1842. It is now said to have been the first heavy fall experienced for fourteen years, none whatever had fallen from our occupation in 1838. On the 11th November 1854, a violent hail storm occurred at Suez simultaneously with the earthquake felt all over the Levant. The following is a list of well ascertained falls of recent occurrence at Aden.

1848, 28th January,—Light rain.
Feb. 27th.—Do. do.
March 20th.—Do. do.
July 15th P. M.—Heavy dust storm with lightning and showers of rain.
Do. 16th—Heavy rain at 1 o'clock. One inch fell in twenty minutes.
August 28th 4 P. M.—Heavy rain with thunder and lightning.
September 4th 2 A. M.—A smart shower of rain.
Do. 5th.—Rain with thunder and lightning.
Do. 19th.—A quarter of an inch of rain fell.
November 21st —Light showers over the twenty-four hours.
Dec. 30th.—Do. do.
1849 April 19th.—Showers of rain with thunder and lightning.
Do. 21st.—A heavy storm of wind and rain; above three inches fell.
July 31st.—Violent thunder storm with one inch and a half of rain.
Dec. 22nd and 24th.—Smart showers of rain.
1850, May 6th and 7th.—Rain with lightning and a heavy gale of wind.
1851, Dec. 12th.—One and a half inch fell.
1852, Jan. 3rd.—Half an inch.
Do. 22nd.—A quarter of an inch.
Do. 28th.—Five inches and a half.
Sept.—A heavy fall occurred; the amount not given.
1853, Dec. 6th.—A quarter of an inch.
11th—half an inch.
1854 Jan. 11th.—A quarter of an inch.
Do. 12th.—Four inches.
Do. 13th.—Light showers.
March.—About five inches; amount uncertain.
May 6th.—Quarter of an inch.
Oct. 25.—Two tenths.

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Oct. 26.—Three inches.

Dec. 5, 7, and 28th, Heavy showers.

1855, Jan. 2nd, 9th, 10th, 11th, 12th. Heavy showers, two inches and a quarter in all.

Aug. 21st.—Half an inch.

1856, Jan. 11th 22nd and 23rd. Heavy showers, one inch and a quarter.

It will thus be seen that for the past ten years, rain has fallen at Aden on six eight days annually,—the total yearly fall being somewhere about five or inches.

On the temperature of the Red Sea I have bestowed a special article at the conclusion.

It frequently happens at the same time that several years on end without so much as a shower, and this furnishes a fair type of the rain of the Red Sea. On the 28th of July 1854, I experienced a heavy fall of rain in the lower part of the Red Sea, which lasted a couple of days. Again, on the 10th of Feb. 1857, we had a heavy squall of rain in passing the Straits of Babel Mandeb.

Currents.—From the general character of the sea as just described, a very singular series of occurrences may be expected to make their appearance near the strait, to compensate an evaporation of nearly a quarter of an inch daily, or nearly 8 feet annually, over an area of 108,154 miles, or in all 165 cubic miles, of water raised in vapour in excess of the little rain that falls. Were the geological theory true, that the water, concentrated at the surface, occasioned a deposit of salt at bottom, the Red Sea must long ago have been transformed into a solid mass, and if the assumptions as to the capacity of the Red Sea be correct, the waters would be dried up in the course of a hundred years, were no water to enter from without. In the course of three thousand years (and for this time it has been known to us) it must have been converted into a solid mass of salt, had the whole saline matter, carried in from without by the current required to feed evaporation, remained within the strait. Yet we know that, in point of fact, it is, at the surface at all events, not one whit more saline than the outer ocean; and we have no reason to believe that its lower waters differ materially from those which float at the surface. The various officers of the survey were, from the commencement of their labours, struck with the extraordinary diversity of the currents within the Gulf of Aden. "My endeavours," says Capt. Haines in a paper prepared in 1849, "to reduce them to principles which might guide others have hitherto entirely failed, but I am at this moment not satisfied how the currents themselves are set in motion, whether by submarine impulse, by a change in the component parts of the water occasioned by different degrees of evaporation, or by the pressure of prevailing winds. At sea I have experienced a current running in circles, or in bands, 60 miles in extent, and have not unfrequently borne up, and set topmast studding-sails with a favourable wind, in order to escape the counter current, when, by observation, I have found

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the vessel in another stream out of the former current, and have hauled to windward again, and beaten fast sailers, which were working in-shore.' This corresponds almost word for word with the account given by Dr. Scoresby of the bewildering currents produced by the tepid waters of the Gulf-stream running N., and meeting the cold and heavy polar currents moving southward: the cause of both being the encounter of streams of water of different weight; the specific gravity of the two depending in the one case on the diversites of temperature, in the other on differences of saltness. The error into which those who assume the salting up of the sea, seem to have fallen, is that of supposing the water concentrated by evaporation to remain at the surface till close on the point of saturation, and then sinking only when ready to deposit its salt, whereas, in point of fact, the instant the upper waters become one atom heavier than those beneath them, they will sink down either till they reach the bottom, or meet with others of the same gravity as themselves. A mass of brine, by ever so little salter than the surrounding waters, may thus accumulate in the recesses of the sea, until it rises to the level of the Mocha barrier, when, by its own gravity, it will at once flow over, and produce an outward under-current, by which the whole mass of the sea will come to be discharged as it is concentrated. Between this and the upper inward-flowing current, required not only to supply the whole 165 cubic miles vaporized, but the vitiated water discharged, there will in all likelihood be a mass of stagnant water brought to rest by its upper and lower surfaces being acted upon in opposite ways by the conflicting currents. These things are matters of physical necessity, dependent on the first principles of hydrostatics, and not requiring experiment for their establishment. It seems more than probable that the Red Sea changes the whole of its waters at least once a year; and we may yet be able to determine the fact by observation. As it is, we know that a strong current sets along the coast of Arabia, towards Meckran and Scinde, the sweeping southward by the shores of Hindostan, where it is diluted by the enormous falls of rain, of which probably not less than 10 feet are discharged into the ocean annually from an area of 24,000 miles, or 40 cubic miles of water, it next crosses the Arabian Sea towards Zanzibar, and gives off its surplus vapour as it returns along the shores of Africa northward to the Red Sea, again to perform the task it originally accomplished. The whole amount of water, evaporated from the nearly rainless shores to the N. W. of the Arabian Sea, probably exceeds 400 cubic miles, the further deficiency being supplied by currents from the southward.

The Shores of the Red Sea.—Around the whole of the shores of the Red Sea is a belt of sand and gravel, sloping inward from high-water mark to a distance varying from some hundred yards to that of many miles. It abounds with shells and corals, identical with those in the sea itself, and is obviously an upheaved beach of comparatively modern date. It is not very easy to determine either the extent or the elevation of its landward margin, as a long series of upheavals appear in these parts to have follow-

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ed each other, so that a much more minute survey than has hitherto been bestowed upon it, would be required before what belongs to each could be determined. I have found Red Sea shells scattered in profusion all over the Desert, between Cairo and Suez, at an altitude of 800 feet, and they are mentioned as existing at an elevation of at least 2000. Dr. Carter describes a cavern near Ras-Morbat, in southern Arabia, the floor of which is a few feet above high-water mark, the roof being 30 feet high, obviously excavated by the waves. The face of the cliff on a level with the roof is full of borings of lithodomi, and Dr. Carter supposes that it was formed whilst slowly emerging from the sea.*

There are many similar caverns in the interior; the roofs and floors of all are incrusted with sulphate of lime, as stalagmites and stalactites. The cliffs along the shore of Africa, towards the mouth of the Gulf of Aden, are found all pierced with similar caves, as I have no doubt those around the Red Sea would be found to be, were they examined; and I have come to the conclusion that the altitude of the most recent of these upheavals varies from 5 to 30 feet, being different at different points.

During his investigations with a view to the construction of a canal between the Mediterranean and the Red Sea, Mr. Cubitt found the level of the two seas the same; and there can be little doubt that the bitter lakes in the isthmus at one time formed the head of the Red Sea. Mr. Stephenson has ascertained that the sea-shells in this district, as well as those on both the raised beaches in that neighbourhood, are the same as those now prevailing in the Gulf of Suez; so that, at a period comparatively recent all the tertiary beds forming the bottom of the sea and the contiguous land must have been elevated from 12 to 18 feet. Historical events afford us a date within which this must have occurred. Six centuries before the Christian era, Darius Hystaspes completed a canal from the Nile, a little above Bubastes, to the Red Sea near Patamos; it was in some places 150 feet wide and 30 feet deep, and was navigable for vessels of considerable burden; while the Nile which supplied it was high, the waters serving for irrigation. The vicinity of several important cities, the ruins of which are still scattered around, indicates that the district at this period was possessed of great fertility and a large population. Within three thousand years, then, the alteration of level must have occurred which rendered it impossible longer to supply the canal from the waters of the Nile. In this view I have adopted both the facts and the inferences of Mr. Cubitt, Mr. Stephenson, Capt. Newbold, Miss Corbaux, and Mr. Glynn, not having crossed it myself;† but I had come to exactly the same conclusions, and published an account of these four years before the earliest of the writings referred to appeared.

* Geography of S. E. Coast of Arabia: Trans. Bon.b. Asiat. Soc., 1851, p. 252.

† Capt. Newbold's Visit to the Bitter Lakes, Isthmus of Suez. Trans. Roy. Asiat. Soc. 1845, vol. viii. p. 356; Mr. Glynn on the Isthmus of Suez, on Ancient Canals of Egypt, Institution of Civil Engineers, 1852; Miss Fanny Corbaux's Letters in the "Athenæum," 1852.

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It is singular that we should know so little that is authentic or accurate of the Wadi Arabá, or the region which intervenes between the Gulf of Akabà, the other terminal point of the Red Sea, and the great depression of Palestine, considering its perfect accessibility and the frequency with which it has been traversed. Even the little knowledge we flattered ourselves that we possessed, has now vanished. A writer in the 18th volume of this Society's Journal, basing, as I had supposed, his conclusions on well-established facts, had placed its length at 105 miles, and its summit level at 495 feet; but Capt. Allen, R.N., has since shown * that we are altogether ignorant both of the altitude and position of its water-shed. We do not profess to know anything of its geology, or the age of its upheaval. The islands in the Red Sea doubtless afford abundant evidence of these various changes of level: but, with the exception of the volcano of Gibel-Teer, and of those described by Ehrenberg, in the neighbourhood of Ras-Mahommed, scarcely one of them has been examined or described in modern times. The "Two Brothers, in lat. 26° 20' N., long. 34° 45' E., are set down in the chart as coral islands, about 60 feet above the level of the sea. The sea immediately around them sinks at once to 50 fathoms. The Red Sea, around its whole circuit, is walled in by vast masses of mountain, which, down to Judda, in 21° 30' latitude, approach close to the shores. On the African side, down to the 16th parallel, isolated hills alone skirt its boarders; the higher ranges 40 or 50 miles off are seldom seen at sea; and on the opposite shore, between the same parallels, the land slopes gently in towards the interior of Arabia. The rocks chiefly consist of nummulite limestone—a portion of the vast band so admirably described by Sir Roderick Murchison, as stretching all the way, in one unbroken line, from the Bay of Biscay to the shores of Aracan, for nearly one-third of the circuit of the globe. From the parallel 16 to 12 the mountains on both shores and the islands in the middle of the Red Sea are volcanic. Gibel-Teer, in lat. 15° 30', is still smoking, as it has been since 1774, when visited by Bruce, by whom it is set down as 500 feet in elevation. Dr. Kirk makes it 300 feet; the surveyors place it at 900: so little do we know of a volcano passed by our steamers at least four times every month. A violent eruption, of short continuance, took place in one of the Zugar islands, lat. 15°, in 1846, which was fortunately seen from different points of view by steamers passing in opposite directions but it has never since been visited. A range of hills, above 14 miles from the shore, to which it is nearly parallel, is laid down in the chart as volcanic on the African side, with a similar range of greater magnitude and of the same character, extending from lat. 12° to lat. 15° 30' on the Arabian coast. Dr. Kirk describes these as extending for about 300 miles to the westward, so that this vast volcanic field, which has carcely been so much as noticed by geologists occupies probably an area of above 10,000 square miles, with-

* Trans. of the Royal Geographical Society, 1853, vol. 23, p. 166.

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out interruption; and is perhaps the third or fourth in point of extent on the surface of the globe. The only one of all its volcanoes with which we are somewhat acquainted is that of Aden, in the crater of which our troops are quartered. It has been so often described that it is necessary here to refer to it, further than to state that it has clearly been submerged and elevated again from the waters, since the latest period of its activity. Up to the altitude of 500 feet it is thickly strewed with sea-shells mixed with scoriæ and volcanic ashes; and in the bottom of the crater and all around the margins of the peninsula are masses of shells and gravel, the same as now prevail in the sea around, and exactly similar to those on the raised beaches of India and of Suez. In September 1857 I was shewn a large bed of as perfectly well preserved shells of the same description as those on the shores of the sea at an altitude of 300 feet, on the ridge between the main pass and the New Works near the Turkish Wall (see Paper on the Geology of Aden).

Note by Captain Haines.—The latitude of the Straits of Babelmandeb I do not think correct. I found soundings all the way across just outside the Red Sea; greatest depth 198 fathoms.

There are, no doubt, many reefs in existence not yet discovered: I reported one in April last, upon which an Arab ship struck.

The height of the water within the Red Sea depends upon the seasons; and after strong N.N.W. winds the shoals in the north part are dry in many places: even the shoals in the centre are influenced in the same way. The Dedelus Shoal can be landed on *at times*.

In January and February it more frequently blows strong from S.S.E. up the sea in the lower part, and the contrary from N.N.W in June, July, and August —*S. B. H.*

DISCUSSION.—*At the meeting following that at which the preceding paper was read the following remarks were made* by CAPT. BARKER.

At our last meeting we were favored by the learned Secretary rendering a very interesting paper on the Physical Geography of the Red Sea. It being late, discussion on the subject was postponed to a future meeting.

It is generally supposed that there exists a perpetual surface current flowing into the Red Sea from the Indian Ocean; such however is not the case. To counteract the effects of this supposed current an undue amount of evaporation, and a sub-surface current has been resorted to, to restore the equilibrum of the waters of this Sea. It has also been asserted that the water at the Isthmus of Suez is lower than at the Straits of Bab El-Mandeb (vide Maury's sailing directions sixth Edition page 113.)

I do not deny the existence of sub-surface currents, but I am of opinion that sufficient attention has not been paid to the prevailing Winds of the

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Red Sea, I beg therefore to lay before the meeting the accompanying Abstract Log kept by me between the years 1831 and 1834, (while engaged in the arduous duties of the survey,) which will tend to elucidate the subject, and show that as the waters flowing into the Red Sea are governed by the prevailing winds, that a corresponding influence exists to cause the waters to flow out *at the surface* in a similar proportion.

It will be observed that during the year 1832, we were principally engaged on the survey of the Coast of Arabia and Islands of the Phassan group; and that during the year 1833, we were principally engaged on the opposite Coast and Islands, and that while on the former Coast the winds tend generally from the Southward and Eastward, on the latter their general tendency in corresponding months is from the Northward and Westward. I have placed the months of the two years opposite each other, that this may be seen at a glance.

I think it much more rational to account for the waters retaining their level by the action of surface currents, governed as we know they are by the prevailing winds, than to resort to an undue amount of evaporation, and sub-surface current.*

During the N.E. Monsoon, that is from October till May, a strong current sets into the Red Sea through the Straits of Bab-El-Mandeb, decreasing in velocity as it advances northward till it is altogether lost. The fact is that the waters thus forced into the Red Sea along the Eastern shore are forced out on the Western shore although this is not so perceptible as the current at the surface does not attain the same velocity on account of the greater width of the channel through which it flows.

During the S.W. Monsoon it is the reverse of this, the waters are forced out on the Eastern, and in, on the Western shore.

I am of opinion that there is no difference between the level of the water at the Isthmus of Suez and the Straits of Bab-El-Mandeb. Early in June northerly winds commence to extend their influence throughout the entire length of the Sea, and by thus giving an onward unchecked motion to the water at the surface, forces a considerable body of water out of the Sea, so that Reefs which are usually covered at low water spring Tides, become dry, thereby causing much sickness (Fevers principally) by the decomposition of vegetable and animal matter, thus exposed to the scorching rays of a Tropical and almost Vertical sun. This decrease or depression of the water is only temporary, lasting but a few days, when a re-action takes place and the waters resume their ordinary level.

* I have taken the evaporation as ascertained at Aden and at Bass Mahommed the lower and upper extremities of the Sea: but it is quite sufficient for my theory that more water is carried off by evaporation than is supplied by rain. There MUST in this case be an outward sub-surface or undercurrent, dependent on evaporation alone. There *may* be abundance of other currents caused by the wind—GEO. BUIST.

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Temperature of the Air at Noon and Sea between Bombay and Aden during the Month of June 1855-56-57 *taken from* 10 *feet under the surface.*

June 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
11	72.01	18.47	88	87
12	68.57	18.17	88	87
13	66.02	17.45	91	90
14	63.50	17.28	90	89
15	61.45	17.05	89	84
16	59.42	16.50	87	82
17	57.23	16.29	87	82
18	55.00	15.36	87	82
19	53.00	15.00	87	81
20	50.57	14.28	88	84
21	48.06	13.08	82	84
22	Aden.		91	84
From Aden to Bombay.				
13	48.06	12.58	92	
14	51.44	13.55	91	
15	56.16	15.10	84	
16	60.48	16.12	85	
17	65.24	17.10	83	
18	69.23	18.05	85	
19	.		84	
20	Bombay.		82	

June 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
11	71.56	18.40	89	86
12	69.21	17.57	92	86
13	68.25	15.03	92	85
14	67.47	11.27	93	84
15	66.29	8.32	92	86
16	63.48	8.03	88	86
17	61.23	8.44	82	85
18	58.49	10.40	85	84
19	55.44	12.46	85	84
20	52.16	13.30	87	86
21	48.13	13.15	90	86
22	45.03	12.45	96	86
	Aden.			
From Aden to Bombay.				
14	48.06	13.13	88	90
15	51.14	14.04	89	91
16	55.17	14.57	85	87
17	59.20	15.43	82	84
18	63.28	16.48	84	86
19	67.26	17.30	85	87
20	71.02	18.20	86	88
	Bombay.			

June 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
16	70.20	18.00	88	85
17	70.00	15.10	83	84
18	68.16	12.43	87	84
19	67.24	9.25	87	85
20	64.58	7.22	88	86
21	62.26	7.06	85	83
22	60.00	7.58	86	82
23	57.30	9.45	82	85
24	54.32	11.50	82	84
25	57.56	12.57	85	84
26	47.52	12.12	93	85
27	Aden.		91	84
From Aden to Bombay.				
12	45.44	12.55	90	86
13	49.01	13.47	88	86
14	52.22	14.25	87	85
15	55.53	15.06	83	81
16	59.20	15.29	84	81
17	63.29	16.24	83	81
18	67.38	16.55	81	79
19	71.00	18.05	84	79
	Bombay.			

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Temperature of the Air at Noon and Sea, between Bombay and Aden during the Month of July 1855-56-57 *taken from* 10 *feet under the surface.*

July 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
11	72.16	18 30	89	85
12	69.43	17.25	87	84
13	66.58	18.52	87	83
14	64.02	20.48	83	80
15	60.52	21.13	84	80
16	60.14	19.30	86	80
17	59.07	18.39	88	83
18	57.27	18.35	81	78
19	55.38	17.12	82	78
20	53.30	15.49	86	81
21	50.30	14.35	85	80
22	48.03	13.23	89	85
23	45.28	12.48	84	85
	Aden.*			
From Aden to Bombay.				
14			86	84
15	49.00	13.46	85	82
16	52.44	14.38	84	83
17	57.07	15.52	82	82
18			82	82
19	65.54	16.62	83	82
20	69.58	17.38	88	83
21	Bombay.		84	81

July 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
11				
12	69.34	18.27	85	
13	67.48	16.08	85	86
14	66.38	13.21	84	86
15	65.43	10.29	86	86
16	64.30	08.01	85	85
17	62.09	08.13	84	84
18	59.34	10.05	82	84
19	56.45	12.03	79	82
20	54.08	13.04	83	83
21	50.54	13.03	86	83
22	48.19	12.38	90	90
23	Aden.			
From Aden to Bombay.				
14			92	90
15	49.21	13.19	90	86
16	54.09	14.18	79	74
17	59.15	15.19	82	78
18	64.12	16.13	84	80
19	68.36	17.26	85	84
20	72.47	18.49	88	86
21	Bombay.		85	82

July 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
15	71.09	18.18	88	82
16	69.12	17.47	87	82
17	68.08	15.10	85	82
18	66 50	12.28	84	82
19	65.45	09.34	84	82
20	63.36	10.51	83	81
21	61.09	11.33	82	80
22	58.58	12.13	83	81
23	56.47	12.49	82	80
24	54.13	13.21	82	78
25	05.53	13.40	81	80
26	49.00	13.08	89	86
27	46.57	12.46	89	86
	Aden.			
From Aden to Bombay.				
13			91	90
14	48.27	12.59	91	84
15	52.38	12 57	83	84
16	57.12	13.40	82	76
17	61.30	14.39	83	76
18	65.37	15.45	85	77
19	69.34	17.01	94	82
20	Bombay.		84	82

* This was a Monsoon passage, by the North West or Arabian route.

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Temperature of the Air at Noon and Sea between Bombay and Aden during the Month of August 1855-56-57 *taken from* 10 *feet under the surface.*

Aug. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden				
14	70.42	18.10	85	87
15	67.44	17.23	86	88
16	64.59	17.04	83	85
17	62.15	16 33	80	82
18	59.48	15.47	80	82
19	57.24	15.16	80	81
20	54.47	14.28	78	80
21	51.50	14.02	84	87
22	49.13	12.45	90	91
23	46.20	12.58	88	89
Aden.				
From Aden to Bombay.				
13	46.43	12.83	89	87
14	49.32	13.14	90	89
15	53.09	14.00	80	74
16	56.36	14.41	77	76
17	60.09	15.36	80	88
18	63.50	16.12	82	79
19	67.25	17.18	88	82
20	70.47	18.10	84	84
Bombay.				

Aug. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
13	71.57	18.38	89	82
14	68.35	17.55	86	82
15	65.27	17.15	84	80
16	62.20	17.42	85	80
17	59.03	17.49	83	80
18	57.21	17.15	78	76
19	54.53	16.44	82	76
20	51.58	15.11	79	72
21	48.24	13.56	81	70
22	45.21	12.46	86	80
Aden.				
From Aden to Bombay.				
13	45.57	12.41	87	85
14	49.39	12.33	85	84
15	53.10	13.55	88	84
16	57.28	15.49	76	76
17	61.58	16.02	76	77
18	66.02	17.13	77	80
19	69.41	18.06	81	82
20	Bombay.		84	85

Aug. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
16	71.13	18.30	81	78
17	69.15	17.24	80	78
18	67.36	16.08	84	82
19	65.57	14.45	83	82
20	64.16	13.30	77	78
21	62.24	13.18	81	76
22	60 12	13 14	80	74
23	57.45	13.00	80	78
24	55.34	12.48	80	84
25	52.36	12.53	80	80
26	49.10	12.37	88	86
Aden.				
From Aden to Bombay				
14	45.57	12.53	85	84
15	50.02	13.06	87	82
16	54.02	14.32	87	70
17	58.34	15.05	77	70
18	62.58	16.08	70	76
19	66.55	17.04	81	79
20	70.58	17.58	83	79
21	Bombay.		84	80

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Temperature of the Air at Noon and Sea between Bombay and Aden during the month of September 1855-56-57 taken from 10 feet under the surface.

Sept. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
1	66.32	18.56	84	82
2	63.44	18.50	81	82
3	61.00	18.14	82	79
4	58.36	17.44	81	78
5	56.19	16.34	82	79
6	54.20	15.36	82	79
7	51.49	14.25	84	78
8	48.50	13.12	90	87
9	46.23	12.39	90	76
	Aden.			
From Bombay to Aden.				
13	72.03	18.51	83	82
14	68.54	18.42	86	82
15	66.02	18.26	84	80
16	63 17	18.04	82	80
17	60.23	17.51	80	76
18	57.14	17.16	79	74
19	54.39	16.00	83	79
20	51.34	14.36	80	76
21	48.02	13.12	89	88
22	Aden.		92	
From Aden to Bombay.				
16	48.56	13.27	87	88
17	51.47	14.14	83	84
18	55.47	15.10	82	84
19	59.29	15.58	80	82
20	63.42	16.47	81	83
21	67.28	17.35	84	86
22	71.01	18.27	84	86

Sept. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden				
1	68.33	16.56	82	82
2	66.35	16.53	82	79
3	63.55	15.01	80	78
4	61.45	14.38	79	80
5	59.32	14.01	79	76
6	57.10	13.38	80	77
7	55.22	13.11	76	75
8	53.40	12.50	80	76
9	51.04	13.12	80	84
10	48.14	12.45	83	86
	Aden.			
From Bombay to Aden.				
13	72.02	18.36	82	85
14	68.48	17.43	82	86
15	65.32	16.58	84	82
16	62.18	16.26	82	82
17	59.29	15.51	79	80
18	56.34	15.54	79	78
19	53.32	14.54	78	80
20	51.15	14.51	81	84
21	47.43	12.58	89	90
22	Aden.		92	90
From Aden to Bombay.				
12	43.05	12.45	91	90
13	49.15	13.16	91	88
14	53.38	14.17	78	84
15	58.22	15.15	83	80
16	62.43	16.14	80	78
17	67.02	17.06	85	81
18	71.22	18.26	82	82

Sept. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
1	17.19	18.40	86	78
2	68.46	18.27	85	82
3	66.12	18.17	84	80
4	63.56	18.08	83	22
5	61 49	18 04	82	82
6	59.17	17.45	80	78
7	56.38	17.10	78	76
8	54.23	16.12	80	80
9	51.22	14.47	83	78
10	47.34	13.33	89	90
	Aden.			
From Bombay to Aden				
16	71.13	18.30	81	78
17	69.15	17.24	80	78
18	67.36	16.08	84	82
19	65.57	14.45	83	82
20	64.16	13.30	77	78
21	62.24	13.18	81	76
22	60.12	13.14	80	74
23	57.45	13.00	80	78
24	55.34	12.48	80	84
25	52.36	12.55	80	80
	Aden.			
From Aden to Bombay.				
13	48.00	13.26	89	86
14	51.32	14.17	90	88
15	55.32	15.25	81	87
16	59.42	16.23	78	80
17	63.58	17.04	80	80
18	67.56	17.49	80	79
19	72.01	18.44	84	80

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Temperature of the Air at Noon and Sea between Bombay and Aden during the Month of October 1855-56-57, *taken from* 10 *feet under the surface.*

Oct. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
4	71.12	18.37	83	82
5	67.40	17.48	85	84
6	63.41	16.57	84	84
7	59.40	16.05	85	85
8	55.35	15.07	85	84
9	51.49	14.02	85	84
10	47.23	13.05	85	84
11	Aden.			
From Bombay to Aden.				
18	72.00	18.44	86	86
19	69.05	18.37	88	86
20	66.04	18.20	85	85
21	62.25	17 56	82	82
22	58.45	17.13	83	83
23	55.18	16.06	85	85
24	51.48	14.52	89	85
25	49.00	13.53	92	84
26	45.50	12.45	89	85
	Aden.			
From Aden to Bombay.				
16	49.03	13.04	86	86
17	52.18	14.04	84	82
18	56.21	14.26	86	84
19	59.45	15.14	84	85
20	63.28	16.04	84	83
21	67.09	17.02	84	83
22	70.12	17.58	84	83
	Bombay.			

Oct. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
4	72.02	18.36	85	85
5	68.11	17.51	85	84
6	64.45	17.00	85	85
7	61.34	15.12	81	84
8	58.02	15.36	83	84
9	55.07	14.36	81	84
10	51.54	14.17	82	82
11	46.07	13.38	55	85
	Aden.			
From Bombay to Aden.				
18	71.50	18.33	90	80
19	67.22	17.44	83	80
20	63.39	16.55	91	80
21	59.45	16.02	82	80
22	55.44	15.36	84	80
23	51.59	14.30	85	80
24	48.19	13.45	82	83
25	Aden.		87	82
From Aden to Bombay.				
15	47.10	12.42	86	86
16	50.22	13.10	86	84
17	53.24	13·56	83	83
18	56.46	14.18	84	82
19	60.00	15.16	81	83
20	63.17	16.05	81	83
21	66.43	17.10	86	84
22	70.06	18.13	84	84
	Bombay.			

Oct. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
4	72.09	18.40	83	83
5	68.39	17.57	85	84
6	65.0	17 13	86	84
7	61.28	16.28	86	85
8	58.03	15.41	81	79
9	54.34	14.52	79	79
10	51.07	14.05	80	79
11	47.42	13.23	82	80
	Aden.			
From Bombay to Aden.				
18	72.14	18.49	87	84
19	68.45	18.40	87	86
20	65.03	17.56	87	84
21	61.20	17.03	84	82
22	57 48	16.09	81	82
23	54.00	15.11	82	80
24	50.16	13.59	84	82
25	46.40	13.12	85	88
	Aden.			
From Aden to Bombay.				
15	48.15	12.58	86	84
16	52.20	13.24	84	78
17	56.12	14.19	82	77
18	59.22	15 43	84	80
19	62.28	16.34	84	80
20	66.16	17.38	89	80
21	70.27	18.20	89	80
	Bombay.			

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Temperature at Noon of the Air and Sea between Bombay and Aden during the month of November 1855-56-57 taken from 10 feet under the surface.

Nov. 1855.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
3	71.52	18.43	83	85
4	67.10	17.34	85	95
5	62.25	16.23	83	82
6	58.04	15.18	82	79
7	53.48	14.22	81	78
8	49.27	13.25	84	82
9	44.59	12.44	83	81
Aden.				
From Bombay to Aden.				
17	71.55	18.38	82	83
18	68.06	18.45	83	83
19	64.12	17.19	84	84
20	60.25	16.28	83	84
21	57.37	15.40	79	84
22	52.43	14.18	81	85
23	48.38	13.24	81	85
Aden.				
From Aden to Bombay.				
17	46.56	13.18	88	85
18	48.50	13.16	87	81
19	51.24	14.26	89	81
20	54 23	15.02	84	81
21	57.13	15.53	83	79
22	60.11	16.50	88	81
23	63.13	17.19	84	80
24	66.54	17.45	84	79
25	69.15	18.14	88	81
26	72.27	18.14	84	83
Bombay.				

Nov. 1856.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
4	70.07	18.13	86	84
5	66.14	17.17	85	84
6	62.27	16.20	86	84
7	58.31	15.28	85	83
8	54.39	14.49	83	82
9	51.06	13.56	83	83
10	47.02	13.22	84	78
Aden.				
From Bombay to Aden.				
18	70.32	18.19	82	81
19	66.37	17.24	80	80
20	62.48	16.16	81	78
21	58.43	15.23	80	78
22	54.34	14.37	78	77
23	50.34	13.35	80	76
24	46.14	12.51	80	78
Aden.				
From Aden to Bombay.				
15	45.24	12.44	81	80
16	48.30	13.29	87	80
17	52.03	14.41	82	79
18	55.35	15.30	81	80
19	58.50	16.52	82	84
20	62.38	17.36	82	79
21	66.26	17.59	80	80
22	70.21	18.40	80	80
23	Bombay.			

Nov. 1857.	Long.	Lat.	Air.	Sea.
From Bombay to Aden.				
4	70.15	18.17	86	
5	66.24	17.17	86	
6	63.01	16.27	82	87
7	59.27	15.36	80	86
8	55.49	14.45	82	
9	52.19	13.46	81	
10	48.47	13.03	84	86
Aden.				
From Aden to Bombay.				
22	33.33	28.03	67	78
23	35.45	24.46	77	80
24	37.37	21.45	86	84
25	39.30	19.05	85	86
26	40 59	16 39	87	86
27	42.16	14.50	84	86
28	43.24	12.05	81	82
Aden.				
From Bombay to Aden				
14	46.59	12.58	84	80
15	45.50	13.26	87	80
16	52.33	13.52	81	82
17	55.15	14.42	81	79
18	57.55	15.38	84	83
19	60.42	16.42	83	83
20	64.00	17.20	84	83
21	67.05	17.51	84	83
22	78.10	18.23	84	85
Bombay.				

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Temperature at Noon of the Air and Sea between Aden and Suez during the month of July 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

July 1855.	Long.	Lat.	Air.	Sea.

July 1856.	Long.	Lat.	Air.	Sea.
		From Aden to Suez.		
1	39.01	19.39	92	90
2	36.52	23.02	90	86
3	35.00	25.54	89	81
4	33.15	28.20	82	78
		Suez.		
		From Suez to Aden.		
8	33.56	27.42	91	82
9	36.06	24.20	82	82
10	38.05	20.48	92	90
11	48.05	17.09	91	85
12	41.45	13.39	91	90
13	43.00	13.39	92	90
		Aden.		

July 1857.	Long.	Lat.	Air.	Sea.
		From Aden to Suez.		
15	43.08	13.25	89	84
16	41.11	16.24	89	92
17	39.40	19.08	88	88
18	37.51	21.37	91	87
19	36.62	24.36	89	80
20	34.08	27.24	83	84
		Suez.		
		From Aden to Suez.		
16	41.11	13.25	89	92
17	39.40	19.08	98	87
18	37.52	21.37	91	87
19	36.02	24.36	89	85
20	34.08	27.24	88	84
		Suez.		
		From Aden to Suez.		
29	43.28	12.42	90	85
30	41.57	15.21	94	88
31	39.56	17.56	94	88
		Suez.		

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Temperature at Noon of the Air and Sea between Aden and Suez during the month of August 1855-56-57 taken from 10 feet under the surface—Noon.

Aug. 1855.	Long.	Lat.	Air.	Sea.

Aug. 1856.	Long.	Lat.	Air.	Sea.
From Aden to Suez.				
22	45.01	12.46	86	80
23	44.09	12.47	84	80
24	41.56	15.26	96	90
25	39.38	18.35	93	90
26	37.34	22.01	94	90
27	35.52	24.51	91	88
28	34.17	27.04	87	86
29	32.56	28.56	85	80
Suez.				

Aug. 1857.	Long.	Lat.	Air.	Sea.
From Suez to Aden.				
8	34.08	27.30	85	83
9	35.49	24.22	85	86
10	37.46	21.22	88	87
11	39.54	18.24	91	87
12	41.52	15.25	91	88
13	41.52	15.25	90	89
Aden.				
From Suez to Aden.				
22	33.26	28.11	83	84
23	35.44	24.44	91	86
24	37.50	21.15	94	90
25	40.20	17.54	94	86
26	42.30	14.30	93	87
Aden.				
From Aden to Suez.				
27	45.57	12.50	87	85
28	45.57	12.47	87	81
29	42.50	14.09	88	88
30	40.42	16.53	91	90
31	38.37	19.56	91	90
Suez.				

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Temperature at Noon of the Air and Sea between Aden and Suez during the month of September 1855-56-57 *taken from* 10 *feet under the surface.—Noon.*

Sep. 1855.	Long.	Lat.	Air.	Sea.
	From Aden to Suez.			
23	43.14	13.07	93	90
24	41.23	16.06	93	90
25	39.22	18.44	92	90
26	38.08	21.23	89	86
27	36.18	23.40	87	84
28	35.06	25.59	85	82
29	33.27	28.18	81	78
30	33.27	28.08	81	78
	Suez.			

Sep. 1856.	Long.	Lat.	Air.	Sea.
	From Suez to Aden.			
7	34.22	27.08	84	86
8	36.27	23.23	90	88
9	39.00	19.47	93	90
10	41.15	16.14	94	92
11	43.28	12.41	93	92
12	49.15	12.45	91	90
	Aden.			
	From Suez to Aden.			
23	34.04	27.33	77	83
24	35.34	24.31	85	84
25	37.40	21.44	87	85
26	39.38	19.05	90	85
27	41.25	16.16	91	86
28	43.00	13.31	92	86
29	43.00	13.31	92	86
	Aden.			
	From Aden to Suez.			
23	43.10	12.59	90	92
24	41.50	15.58	96	94
25	39.40	18.48	97	92
26	38.02	21.42	90	96
27	36.14	23.57	87	88
28	34.34	26.43	86	84
	Suez.			

Sep. 1857	Long.	Lat.	Air.	Sea.
	From Suez to Aden.			
7	34.34	26.52	89	85
8	36.31	23.31	94	90
9	38.48	20.12	94	88
10	40.50	16.56	95	90
11	43.66	13.41	90	88
12	43.06	13.41	91	88
	Aden.			
	From Suez to Aden.			
22	34.03	27.28	79	85
23	36.13	23.44	83	90
24	38.30	20.26	86	90
25	41.00	17.04	90	92
26	42.59	13.14	92	92
27	42.59	13.14	90	90
	Aden.			

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Having given these very valuable Tables at length, I shall now endeavour to make such an analysis of them as may afford at a glance the substance of the information they contain. Though not directly bearing on the physical condition of the Red Sea, I shall take up first the observations on the Arabian Sea, as this will dispose, though somewhat out of place, of a matter requiring to be taken up when the consideration of the vast expanse of water comes before us.

The tables first given are those obtained from the logs of vessels proceeding from Bombay to Aden, then of those returning. In the abstract we concern ourselves exclusively with the position of the ship, the direction in which she was moving is immaterial.

COLD SEASON.—Grouping November, December, Jan., Feb. and March together as constituting the Cold Season, we find a considerable uniformity in the laws of temperature and probably much as we should have expected.

During these four months the air betwixt the meridian of 65 and 72 E. and parallels of 12 and 20 N. seems always hotter than the surface of the Sea. The temperature of both sea and air are higher on the shores of India lat. 19—than of those of Arabia and Africa lat. 12,—a result not to have been looked for when it is remembered how the air with us is freshened by the most luxurious vegetation, and cooled by the majestic masses of the Ghauts and the deluges of rain of our S. W. Monsoon. On the shores of the Gulf of Aden we should have expected it to be heated to suffocation by the barren rocks and arid deserts on every side. The temperature proceeding from Bombay westward and southward, especially of the Sea, continues to decrease where it might be expected to increase, and reaches its minimum betwixt the 14th and 16th paralels and 55 and 61st meridians—in fact betwixt Socotra and to within seven degrees of Aden, where the water ranges from 76° to 80°, the air being warmer by from 2 to 3 degrees.

APRIL.—A series of new laws now comes to be described, and April must be taken by itself. The temperature of both sea and air have taken a sudden jump, neither ever getting lower than 79, rarely below 82°, both occasionally reaching as high as 87. During the cold season, we have found the temperature higher on the shores of India, lat. 19, than on those of Arabia lat. 13. This state of matters is now reversed: and the air and water within 300 miles of Aden, are almost invariably warmer than within a similar distance of Bombay. The air continues in general hotter than the water, but less so than during the previous five months. The region of maximum heat of sea and air takes the place of the previous minimum about the entrance of the Gulf of Aden.

MAY.—The temperatures of May, are nearly the same as those of April, only that the sea and air are less in harmony than before. We have the latter frequently at 90° when the former does not get beyond 84° and the Aden is now very much warmer than the Bombay end of the line.

JUNE.—Both temperatures become irregular, jumping up and down most likely according to the earlier gusts of the monsoon. On the whole the air

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is about 3_0 higher than the water though the latter several times gets above 90° —the influence of the rains in lowering the temperature on the shores of India now becomes conspicuous.

JULY.—The Monsoon effects a large reduction in the temperature for July—the sea only twice reaching 90° in both cases just off Aden, never otherwise rising so high as 87° In an experimental Monsoon trip where the steamer stood westwards towards the Arabian shore in place of southwards, the temperature of the sea betwixt the 17th and 18th paralels and 55th and 57th meridians was 78° the air being 81°, five degrees lower, in both cases than the air and water at that date at either end of the line. The region of minimum temperature was once more westward of Socotra but the water had fallen here nearly five degrees below the averages of the previous three months, ranging from 76 to 78°.

AUGUST AND SEPTEMBER.—We are now presented with some singular anomalies, as the S. W. Monsoon begins to draw off. The temperature of the eastern portion of the Gulf of Aden, which in July had stood above 80. or 82 at an average, now sinks down to 78; sometimes to 72 or 70; the air being often ten degrees hotter than the water, the averages of both of those off Aden being nearly the same as before.

OCTOBER.—Differs from the preceding months in the general and somewhat rapid rise of the temperature especially of the water—which, though once reaching 77 and several times 79 rarely falls below 81°, rising occasionally as high as 85°. The temperature of the air and water during October approach more nearly to each other than during any other part of the year.

And this brings us round again to the cold season already examined. I have throughout discarded the heat in the harbours of Aden and of Bombay, these, especially the former, being so much modified by local causes as to permit of no general conclusion being drawn from them.

From the Tables it will be seen, that the temperature of the Arabian Sea betwixt the 12th and 19th parallels is throughout the year above 82° or nearly three degrees higher than what might have been expected, and that the coldest portion for ten months at least is what, judging by the latitude, ought to have been the hottest, the southwest opening of the Gulf of Aden betwixt the shores of Africa and Arabia.

We now come to the examination of the Tables, giving the temperature of the Red Sea betwixt Aden and Suez; this includes a space of 80 miles eastward of the Strait of Babelmandeb, where the Red Sea in reality opens.

The Temperature Tables betwixt Aden and Suez do not admit of the same minuteness of analysis as is permitted of those of the heat betwixt Bombay and Aden; and there is no occasion for classifying them into seasons. From Aden to the Straits of Babelmandeb, in lat. 12 30 N. and long. 43.40 E. the ship steers nearly on the parallel. After getting quit of the high temperature of the anchorage, the sea and air continue pretty much as they are further east the Gulf. Just within the Straits we get to a fearfully hot portion of the sea, the highest temperature prevailing betwixt 14 and 2P

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that could be discovered, was a notice in the Geological Transactions of 1846, by Mr. Smith of Jordanhill, hardly half a page in length. On my return in August last, I re-examined all the points previously traversed, with the exception of the upper part of the rock, for which time was not on this occasion permitted, directing particular attention to Europa Point and the chasm or rupture called "Hole in the Wall" near Windmill Hill Barracks, as well as the Sand apron at Catalan Bay; I now give the results.* Gibraltar forms a magnificent mass of mountain facing eastward, and presenting an almost mural precipice on the Mediterranean side of from 1250 to 1470 feet in elevation. Its axis is nearly due north and south; measured on the chart it is from Europa Point to the base of the cliff rising from the neutral ground 5120 yards, or above two miles and three quarters. From Catalan Bay to the harbour it is 1000 yards, or nearly three-quarters of a mile across. It is terminated on the north by a precipice 1350 feet in height, and here is planted the Rock gun, the highest on the peninsula. It is united to the mainland by a low isthmus from half to three-quarters of a mile across, and two and a half miles in length—a raised beach consisting of sand, shingle, and shells, such as now prevail in the sea around. The highest point is about two miles along the ridge, where the little turret called O'Hara's Tower is built, on a point 1408 feet above the sea. From this it descends by a steep rugged slope towards the table-land called Windmill Hill, a plateau about 350 feet in height. Another step or precipice descends to the flat at Europa Point, a lower plateau 150 feet above the sea, surrounded by a precipice deeply caverned by the breakers. An overhanging cliff for about half a mile along betwixt "Hole in the Wall" and Catalan Bay prevents the possibility of reaching the one from the other, expect by sea, or a circuit of nearly the whole rock,—a source of much disappointment to me, as I had pushed on much further than I should otherwise have done, hoping to reach the sand apron at the Bay by a short cut. I was compelled to retrace my steps and once more traverse the town, so that a walk of about ten miles performed during the three hours I was allowed ashore, left but little time for drawing or observations.

The prevailing rock on both sides of the Strait, is a siliceous sandstone of a yellowish brown colour, generally associated with limestone and shale in different states of induration, the subordinate beds of chert and coal probably belonging to the Jurassic group. The Gibraltar limestone contains casts of marine shells chiefly *Terebratulæ*.† It forms a long precipitous

* Since the meeting of the Society, I have fallen in with the extended paper of Mr. Smith of which that adverted to in the text is an outline merely. I have drawn from it freely. I was not aware until now that fossils were found in the central rock, and I am indebted for this to Mr. Smith's paper exclusively. I have quoted it only on those points where I had not the means of examining the facts for myself, or where he goes more minutely into particulars than I could venture to do. The only matter of novelty almost which remains for me, is that referring to the cemented sand which he regards as *drift*.

† Mr. Smith *verbatim* Lon. Geol. Trans. 1846. p. 41.

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ridge, the Mediteranean face of which has already been described, sloping gradually westwards to the town and harbour, which forms a beautiful horse shoe six miles across, directly opening out upon the Strait—here nine miles in breadth. The mass is divided into three sections, the northernmost called Walf's Crag, the central one Middle Hill or Signal Station, and the Southernmost and loftiest O'Hara's Tower or Sugar Loaf Hill. The great mass of the rock is a hard compact pale bluish or grey limestone, resembling in appearance similar masses which constitute the sea cliffs at Marseilles, and the mountain range over which the high road and railway ascend from Trieste towards Galatz. The strata of Middle Hill dip westerly at an angle of from 9 to 40, and have been much broken and shivered both in the strike and vertically; to such an extent indeed as to look saving in colour like Basalt, when seen at some distance from the sea. Some violent ruptures and dislocations have taken place at the western and southern base of Sugar Loaf Hill, where we have a vast line of covered ways and galleries, as if Nature meant to contrast the majesty and magnitude with which such things were constructed by her, with those around, the handiwork of man. Here are enormous fragments of rock lying loose on the surface, or cemented together by material corresponding with the littoral concrete of our shores.* A bed of "littoral concrete" extends along the base of the precipice towards the northwest, at an altitude of 60 feet above the sea, forming the site of the town and gardens. This is obviously an elevated beach, of which there seem to be three or four on the harbour side of the rock. The Bone breccia, if it may be so called, is very much older than this, though greatly newer than the rock itself. It is supposed by Mr. Smith, with all appearance of truth, to have come into existence when the limestone beds, now inclining at an angle of 30° were nearly horizontal and not very greatly above the level of the sea; and he assumes, with great probability, a succession of depressions and upheavals of magnitude and abruptness such as to account for the present fractures and derangements on the Rock. The Bone breccia consists of angular portions of the old grey limestone; with like portions of the beautiful Travertine generally known by the name of "Gibraltar Rock," cemented together by a brick coloured earthly material chiefly calcarous. In some places again, the Travertine itself, of much more recent age than that constituting the fragments, forms the commenting material, and it is quite clear that the existing Breccia is partly recent and partly formed from the fragments of an earlier Breccia, shivered to pieces by some convulsion, not suffiientlygreat to prevent the operations it disturbed, from proceeding to go on. The Travertines, both

* This term, which is of Bombay origin, indicates distinctly and intelligibly a particular variety of rock, formed by the cementation of sea-sand or shells, the same as those now prevalent along our shores. The term sandstone is associated in the mind with something arenaceous—Littoral Concrete being often highly crystalline, and without one atom of Silica and is apt to be confounded under this name with formations of divers characters and oldedates than the very latest.

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tus. At the date when the running waters of the Nile discharged themselves into a marsh bordering on the Theban province, terminating in a stagnant estuary 200 miles south of the present sea shore, they would have their velocity checked, and their height and overflow increased according as they were ponded back. The position of the various registers bears out the theory of a succession—the level and flow of the river being modified by the position of its line of debouchure—this again being dependant on the relation for the time being, betwixt the levels of the land and sea.

registers extant, but three of them are fallen from their place, and only fifteen are available at the present time. These are all far above the highest point the inundation now reaches, and the average of them proves that when they were engraved the Nile reached a point 24 or 25 feet higher than it does now. Hence Lepsius concluded that since that period the bed of the Nile, at least this part of it, has been hollowed out to that extent; and some such theory seems to have been generally adopted, though Mr. Horner published a paper in the *Edinburgh Philosophical Journal*, which has subsequently been reprinted in the translation of Lepsius's 'Lettters from Egypt,' published in 1853,—showing how impossible it is for so gentle a river as the Nile, flowing at a rate of about two miles an hour over the hardest rocks, to have excavated its bed to so great an extent. Every one, however, appears to have overlooked the fact, that the earliest but one of these registries is the lowest of all, and that it was not until twenty-one years afterwards the highest point was reached. The dates of the registries now standing are the years 6, 9, 14, 15, 20, 21, 22, 23, 24, 30, 32, 37, 40, 41, and 43, of the reign of Amenemha, and the fourth of his successor. Unfortunately, Dr. Lepsius has, so far as I know, only published the measurements of three of these,—namely, the ninth, fifteenth, and thirtieth years of the reign of Amenemha. That of the ninth is lowest of all, 9 feet above the present ordinary level of the high Nile,—this one, however, is on the opposite side of the river to all the rest, and as I gather, a little lower down the stream than the others, which may in part account for the difference. The lowest on the opposite or eastern bank is that dated the fifteenth year; it is 13 feet above the present ordinary level. The highest of all is the one dated the thirtieth year, and is 26 feet 8 inches above the present level. Hence it appears that there has not been a gradual decrease since these records were engraved, nor a sudden decrease at the time, but in the first instance a great and apparently irregular increase for several years, at least twenty four, and then a decrease for several years more, of which we have six entries remaining, some later ones having fallen. I am too little accustomed to considerations of this nature, and possess too little knowledge of the character of the Nile country above Semneh, to attempt offering any explanation of the phenomena in question, but perhaps if the real nature of them be placed before the public some one more competent might do so. I am, &c., W. HURLEY.—*Athenæum*, 30*th May* 1857, p. 700.

The Bed of the Nile.—In the *Athenæum* of the 30th of May [page 700], appears a note by Mr. W. Hurley on the discovery by Mr. Lepsius of certain engravings, partly on rocks, partly on some ancient foundations, which record the height of the inundations about 4,000 years back from the present time. From these it appears that at this date the Nile reached a point 24 or 25 feet higher than it now ever does. Every one says Mr. Hurley, seems to have overlooked the fact, that the earliest but one of these registers is the lowest of all, and that it was not till twenty-one years afterward the highest was reached. Hence, says he, it appears there has, since these records were engraven, been apparently a great irregular increase in the

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In the very admirable papers of Colonel Baird Smith and Dr. McClelland published in the Calcutta Journal of Natural History in 1840 (Vol. I. 326 and 455), on the Delta of the Ganges, a deposit which has been far more carefully and philosophically examined than that of the Nile—the assumption, which now seems almost self-evident, is started with : that Lower Bengal, when the present silting up began, was an arm of the sea, and that the mass of deluvium measured to the depth of 430 feet, or ten times that to which the Nile has been examined, was deposited through a succession of

spread of the inundation for several years, and then a decrease for several years more, of which we have six entries remaining. These circumstances have an importance attaching to them of which the writer who draws attention to them was not, perhaps, aware ; and I think I can afford the solution of what seems to him a difficulty. In making, in 1837, a survey of the alluvial deposits on the banks of the Tay, in Scotland, I observed that the bed of peat and tree-roots found in the bottom of the river, called a submerged forest, below low-water mark, was covered with several feet of mud, and above this with a bed of cockleshells, obviously in the position in which they lived. Above this, again, were some 10 or 12 feet of alluvium ; and this arrangement was, on digging wells, found to prevail for many miles all over the lower portions of the Carse of Gowrie. The conclusions drawn from this, in a paper 'On the Geology of Perthshire,' published in the *Transactions* of the Highland Society in 1838, were, 1st, That when the peat bed containing the freshwater remains, was deposited what is now the basin of the river must have been a morass above the level of the sea. 2nd, That this descending, and salt water estuary was established,—the cockleshell bed came into existence below high-water mark,—the whole continuing to go down till the present alluvium of the Carse came to be deposited from the supernatant water. 3rd, After this, an upward motion ensued, bringing all the beds into their present position. The passage was quoted at the time. I believe the inference was accepted by Sir Charles Lyell. Soon after this, I published an account of the raised sea-beaches belonging to the same class of phenomena observable all round Great Britain. In 1849 I found near my own house in Bombay exactly the same arrangement as that prevailing in the Carse of Gowrie ; and soon after was able to trace it from Suez all round the borders of Arabia, Hindustan, so southward along the shores of the Mauritius, and I believe, indeed, all over the world. Papers were published by me on the subject in the *Reports* of the Bombay Geographical Society, and in the *Transactions* of the Bengal Asiatic Society for 1850, and again in the Report of the British Association for 1852. In a paper 'On the Physical Geography of the Red Sea,' read before the Royal Geographical Society of London, April, 1854, the following conclusions are stated to have been arrived at:—1st, That within three thousand years of the present time an elevation of the land to the extent of from 5 to 30 feet must have occurred, so as to raise the bed of the canal cut by Darius Hystaspes, some centuries before our era, to prevent the waters of the Nile reaching the land of Goshen and other places on the upper margin of the Delta, where the remains of important cities are still to be found. It would be too much to draw on your space by enumerating the grounds on which these conclusions are based ; they will be found fully set forth in the papers enumerated. This elevation was shown to have been everywhere shortly before preceded by a depression of at least 20 feet—this in many cases having occurred suddenly, if not instantaneously. These phenomena most fully explain the circumstances attending the registers of Lepsius. The oldest of the inscriptions, now the lowest, was carved as the downward mo-

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depressions and upheavals in comparatively tranquil waters. The time consumed in this operation is estimated, on data as exact as the case permits, at above 3,500 years. The bones and fragments of wood found at this depth, had not lost their structure or even their sap; their solid matter was scarcely changed and there is little reason to doubt but they were at least as old as the bit of pottery to which an antiquity of 13,000 years is assigned. The mangrove wood found 10 feet beneath the upper surface of our Bombay raised beaches is fresh enough to be turned on the lathe.

It may seem very presumptuous for any one in India, to enter the lists with an Owen or a Horner on such points as these, assented to apparently by an assemblage of the first philosophers in Europe, to whom they were addressed. But in Science, as in Religion, the precept is imperative to "call no man master, to try all things and cleave to that which is true." The volumes of Revelation and of Nature are alike open to all men—alike are they illuminated from above. In studying them no man is warranted in trusting to the eyes of others, in abandoning the right of private judgment, or in diverging in sheer indolence and unconcern, from the right path, because illustrious men may have led the way.

tion was in progress; the highest when this had reached its maximum. From this date the basin of the Nile rose: the waters consequently, *appeared* to recede. The theory, though quoted with apparent acceptance by Sir C. Lyell in 1841, three years before Lepsius's Letter appeared (in 1844), seems not to have been quite taken in by geologists; and yet it explains thousands of phenomena—as, for example, that of the formation of river deltas—otherwise so unspeakably perplexing to us. The importance attaching to Mr. Hurley's inquiry is, that it affords us specific dates for the occurrence of these movements. If Mr. Hurley will refer to the very excellent letters of Miss Fanny Corbeaux, published in the *Athenæum* for 1852, he will find much on the changes of level in Egypt that will interest him. The science of Geology professes to endeavour to record and explain the various agencies which have operated in bringing the earth into its present form; and yet of late years we have been mainly confining ourselves to the peculiarities and condition of the vegetables and animals which at different ages flourished on its surface. GEO. BUIST.—*Ibid. July* p. 919.

Bed of the Nile.—If the whole basin of the Nile underwent a subsidence and then a subsequent elevation, as described in the *Athenæum* of July 18 by Dr. Buist, the waters of the river must have participated in the event and have preserved their relative level with the banks. The registries at Semneh require for their solution some phenomenon which should apply to the water alone, not to the banks. W. HURLEY.—*Ibid.* p. 949.

Torquay, July 21.

The river Nile of course rose fell with the dry land constituting its basin but the sea retained its level. When before the basin of the Nile had sunk so low as to enable the sea to reach the Thebaiad the river waters must have become ponded back and rendered comparatively stagnant by the salt water of the estuary so as to make the inundation attain a higher level than it had previously done. The statements of the priests made to Herodotus on this point fully explain one division of the phenomena. No mention is any where made so far as I know of the sinking of the land which enabled the waters of the Mediterranean to extend themselves Southwards. The whole of the facts here mentioned and of others of like kind seem to relate a general depression and reelevation of the shores all over the world. nd at dates closely corresponding with the Noachean deluge.

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APPENDIX A.

METEOROLOGY.

DATE OF THE ELEPHANTA.—As the approach of this somewhat turbulent and noisy visitor is now most probably close at hand, the expectant reader may possibly feel some interest in knowing the times of its coming during the past seventeen years, and the most notable of the circumstances attending it. The designation which these Autumnal storms bear, all over this side of India, is conferred on them as occurring about the time when the Sun is in the Constellation *Hust*, the Sanscrit for elephant. As they reach Bombay from nearly due east their name is not unnaturally imagined to have been conferred on them from the celebrated island from the direction of which they reach us. The Elephanta commonly makes its appearance a fortnight or so after the weather has fairly cleared up, when showers have almost ceased to fall, the barometer has become high, the sky bright and clear, and the alternating sea and land breezes have set in. For three or four evenings before its appearance, superb piles of thunder-clouds are seen to accumulate about 3 o'clock every afternoon over the Ghauts: they soon ascend some way in the air, advancing apparently against the sea breeze,—that is, the upper and lower strata of air move opposite ways to each other. Magnificent displays of lightning, with low growling thunder, prevail as twilight sets in: an hour or two after sunset the sky resumes its serenity. At length the clouds grow darker and more watery—the thunder becomes louder, the lightning more brilliant—they tumble up the sky, rolling in vast masses over each other, till a sudden squall bursts in on us, and a deluge of rain follows. This scarcely ever occurs earlier in the day than 3 P. M., and it very seldom continues till dawn; though after three or four hours' interruption it sometimes resumes before noon next day. When the gale is fairly over, the sky in general clears up at once, the clouds vanish, the alternate winds resume sway—hot days and dewy nights succeed and the settled season commences. During the squalls we occasionally experience in March and April, the barometer usually falls, or becomes very irregular, and pending the July storm it sinks very low indeed, and its range becomes singularly small. The bursts in the beginning of June and October, which herald in and close the S. W. Monsoon, seem purely electrical,—neither the pressure nor humidity of the air being materially affected by them. And now to our chronology.

1840.—The Elephanta set in on the 10th Oct., with a violent dust and thunderstorm and quantities of rain, which continued from about an hour before till two hours after sunset: the wind blew in sudden and uncertain gusts from nearly due east, bringing with it perfect sheets of rain. The thunder ceased in a few hours' time, but the rain continued for nearly forty hours with little interruption. On the evening of the 11th it drew off, when all became tranquil and quiet, and we had no more storm that year.—Fall for the monsoon, 63·15 inches.

1841.—After nearly six weeks of bright, tranquil, and cloudless weather, a violent thunderstorm occurred on the evening of the 16th October. The sky continued thick and louring, with lightning in the evening, till midnight on the 17th, when a violent burst of thunder and rain occurred: the thunder soon ceased, but the rain continued for a couple of days, water standing everywhere in pools, and the ground being apparently as wet as in June—Monsoon fall, 71·49.

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,,	16th	Sun.	885	860	883	803	846	Sun.
,,	17th	838	8[illegible]9	833	863	796	Sun.	
,,	18th	864	893	914	806		840	573
,,	19th	811	892	819	778	821	839	525
,,	20th	803	890	839		760	997	
,,	21st	781	876		852	758	793	
,,	22d	807	Sun.	754	898	761	799	
,,	23rd	Sun.	869	668	832	764	785	
,,	24th	822	864			739	Sun.	
,,	25th	556	570	711	826		735	
,,	26th	812	812	700	837	703	733	
,,	27th	818	804	[illegible]	819	774	659	
,,	28th	812	789	692	851	807	631	
,,	29th	797	782			659	719	
,,	30th	768	Sun.	741	917	663	739	
,,	31st	Sun.	774	723	880	570	747	
June	1st	817	777	732	806	535	725	
,,	2nd	788	767	714	818		705	
,,	3rd	764	714	750		644	730	
,,	4th	785	673		862	735	737	
,,	5th	803	Sun.	724	797	792	734	
,,	6th	Sun.	692	735	759	834	742	
,,	7th	767	695	706	227	746	Sun.	
,,	8th	741	734	708	675		739	
,,	9th	730	737	711	665	632	730	
,,	10th	703	786	747		599	717	
,,	11th	689	616		740	664	748	
,,	12th	711	Sun.	745	738	719	744	
,,	13th		702	690	764	668	629	
,,	14th	691	736	693	706	644		
,,	15th	631	765	746	721		681	
,,	16th	584	756	738	782	695	692	
,,	17th	543	760	695	Sun.	654	637	
,,	18th	503	674		675	660	597	
,,	19th	507		637	663	722	646	
,,	20th	Sun.	670	689	693	733	648	

An abstract of the Meteorological Observations at the Observatory is published in all the papers every Tuesday and the reader may probably find it interesting to compare these, as they appear, with the figures entered in the preceding table.

On Thursday evening there was a splendid halo around the moon, from half-past 6 to 8 o'clock. The circle was quite complete, it enclosed in it the planet Jupiter besides the moon, and occupied a space of about 30 degrees. This is usually a sign of rain at no great distance, and yesterday we had a haze over the sky for the greater part of the day. We have little doubt we shall hear in the course of the week of wet weather within a hundred miles of us—*Feb.* 1858.

On Saturday night there was one of the most magnificent halos round the moon we ever remember to have witnessed. There had been a thin haze with a few cumulus clouds all over the sky throughout the day. In the evening the cumuli vanished, and at sunset we had those sheets of fiery-red vapour both in the east and west, which at times make our sunset skies so magnificent. The full moon looked a pale sickly green, as her struggling rays endeavoured to penetrate the lurid veil. So soon as she approached the zenith, the halo about to be described, made its appearance, and was peculiarly magnificent from 10 P. M. till 2 A. M. Its ring was about 20 degrees in diameter, quite perfect all around. Its breadth across about 3°; it was of a bright wheyey hue without irridescence, but changing to a deep purple inside. The planet Jupiter was the only star discernible in the neighbourhood; at midnight he was just without the western outer limit of the ring, so that a reference to the *Nautical Almanack* will give the exact positions of the moon and planet and the dimensions of the halo. A reference to the nearest star at any time, when such things appear, will be

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found to furnish a very simple and precise mode of determining the leading fact regarding them The ring was a very insignificant part of the wonder. From its south-western verge shot a long perfectly straight band of light about 20 across, and at least 500 in length, well down to the horizon; this could barely be traced within the circle and up to the moon, where it vanished. From each side of the circle shot two similiar beams southward, joining the central beam near its extremity, while two others proceeded in the opposite direction, meeting about 20° north-westward of the halo, the whole forming a figure exactly like the framework of a boy's kite. All this was probably due to a sheet of vapour over Bombay and may not have been at any very considerable distance; and we should feel greatly obliged to any one who could tell us how far away it was actually seen and what appearance it presented from other positions.—*Bombay Standard, October* 1858.

"Extraordinary appearance at Sea.—The crew of the *Luck Ashton*, on her last outward voyage, witnessed a singular phenomenon when approaching Alexandria on the 3rd February last. At noon-day the sun became almost invisible and a dense fog obscured the sky; the ship with her spars and rigging, was covered with a fine powder, which entered the ears and mouths of every individual on board, causing the greatest inconvenience. The utmost alarm was felt on board, and some dire calamity was apprehended. The hatches were battened down and Captain Kinlap, the commander of the vessel, put her about and ran out to sea again. During the time of this almost complete darkness the wind was blowing from the south, and the sea was frightfully high. Although the *Lucy Ashton* proceeded some forty or fifty miles out to sea again, still this dense fog pravailed far to seaward; and towards the coast, darkness literally overspread the land of Egypt. This phenomenon lasted for about six hours, when the fog cleared away, the wind lulled, and the sea went down. This extraordinary appearance was supposed to be owing to a sand storm, but its extending so far to sea is considered a most unusual circumstance. From the direction of the wind storm must have originated in the Sahara desert. The people on board the *Lucy Ashton* found afterwards that the storm had blown down trees, forced cattle in to the canal between Alexandria and Cairo, and otherwise caused considerable damage and loss."

Some very beautiful experiments have just been performed by Dr. Girand on the quantity of salt contained in rain falling at different seasons, and with the wind in different directions. No water is ever quite pure; rain generally contains some nitrates and always a sensible quantity of muriates. When our first monsoon rain falls, it descends in such gushes with the wind from off the sea generally so violent, that it may readily be supposed to contain a considerable quantity of spray in a state of mechanical mixture. As the season advances and becomes more serene the salt diminishes. The rain experimented on was collected in a zinc funnel a foot in diameter, 40 feet above the ground and 110 above the sea, communicating by a tin gas pipe with a clean zinc cistern. The first specimen was from that which fell betwixt the 10th and 24th Sept., with the wind strong and from the S. W. Twenty thousand grains of water yielded 0·240 grains of chloride of sodium—sea salt. The next specimen was of rain water collected under the same circumstances during the squall of the 10th October, with the wind from north-east and east; the same quantity yielded 0·126 of salt, or half that of the preceding specimen. The interest attaching to the second experiment lay in this,—that we had had no rain for a week before; the sky had for some days been pure and serene, the aqueous vapour not suspended but dissolved. One would have imagined this the most delicate alembic that could have been resorted to, to obtain absolutely perfect distillation. It will be curious to have the experiment renewed as the season advances. We generally have copious showers in the first week of November, a month after the N W. Monsoon is fully established and precipitation is the result most likely of some form of electric action and not certainly, as in the S. W. Monsoon, of air close on the point of saturation, impinging on a cold mountain mass, and having its capacity for moisture diminished as it ascends towards the summit of the Ghauts. These form very striking facts in physical geography, and are worthy of special notice.

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family are found in India and Ceylon; one or two have plates not scales on the head. They have nasal fossæ.

7. *Crotali* (Rattlesnakes) confined to America. It would assist our knowledge of the subject of the snakes of Sind were classes under the foregoing families, and the native name of each variety given. It would also be desirable to have some account of the different effects of the venom of each family of variety; some seem to produce strong convulsions others coma. Different remedies would probably be required for each, though in all cases cauterization would probably be of service, if taken in time. Any particulars of the habits of different families or varieties would be acceptable: whether they attack men without provocation—if so, under what circumstances; whether more than one variety is common in the same district: the different localities in which they are found, whether (1) viviparous, (2) ovoviviparous or (3) oviparous.

Preserving Specimens.—The usual mode of bottling the snake in spirits of wine is very unsatisfactory; probably the specimens might be skinned, by being opened at the belly, the skin well rubbed with arsenical soap, and then filled with sand, and sent home in that condition. Care should be taken about the preservation of the head and poison fangs. It would also be desirable that drawings of each varieties, colored from life, should be taken, as the colors are apt to fade.

Means suggested for their destruction.—The most effectual is that about to be adopted—a reward for the head of every venomous snake. It would be as well perhaps to offer an additional reward for every head killed in early spring, before they begin to breed, and at the same time there would be less danger from the bite, as the snake is less vigorous and his venom less active. In addition to this, the birds and animals which feed on snakes might be protected: e. g., the Stork-buzzard or the "Secretary" might be imported from the Cape of Good Hope. The Ichneumon, the Hedgehog, and especially Pigs of all kinds, wild as well as tame, are great destroyers of snakes. In some countries, varieties of harmless snakes kill and *eat* poisonous snakes. (In America, the black snake is the greatest enemy of the Rattle snake). If such varieties are found in Sind, they should be protected. It would be curious to enquire how far the traditions which are common about snakes in different parts of the world are known in India e. g., that some particular individuals have a fascinating power over snakes, one condition being that neither the individual nor his father has taken the life of either man or snake—this is an Asiatic myth;—any particulars of the serpent worhip which is susposed to exist among some tribes of the aborigines! *The Snake Charmers* —whether a particular caste (as in parts of Africa); whether they ever handle them when in possession of the fangs; the fondness of the snake for milk. whether anything is known in India of a story common in parts of Spain and in South America—that snakes will suck the breasts of women when asleep, and will follow a woman who is giving suck to a child! whether venomous snakes will receive their young, when small into their mouth on the approach of danger—if so, what varieties; whether any besides the Vipers!

At daybreak on the morning of the 6th March 1858, a magnificent Tiger was observed from the P. &O. Co.'s Steamer *Aden*, swimming from the opposite shore towards Mazagon Bunder. A boat was immediately lowered, and chase given. In about fifteen minutes the rowers were within reach, when they found the noble savage in the act of attempting to board a Native buggalow at anchor, where the people were yelling with all their might and doing their utmost to keep the enemy at bay. A volley from four muskets made him wheel round, and with a tremendous roar he made for his new assailants. A second discharge proved fatal, when he was taken in tow and hoisted on board. It proved to be a fine male tiger beautifully marked, in the highest condition, his fur scarcely at all injured. He weighed 353 lbs. from the snout to the tail, he was 8 feet 9 inches, the tail itself being 3 feet. He did not appear at all fatigued when first seen, and must have swam at least four miles, unless he had taken a rest for the night on Butcher's Island, still two miles from the anchorage; he had the benefit of a strong descending tide. Had he reached the shore, or boarded the buggalow, he was pretty sure to have made a meal of the first man he met with. About thirty years ago a tiger swam across the harbour

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and landed at Mazagon. The little schooner for the Indian Navy, building in the neighbourhood, was on the point of being launched, and Sir John Malcolm caused her to be named the *Royal Tiger* in commemoration of the event.

APPENDIX C.

BOTANY.

The lovers of jungle flowers have an excellent opportunity of studying the growth and economy of our tree cottons—three of which are in full blossom. The most conspicuous of these is the *Bombax Malabaricum* with its great thorny stem and leafless branches and magnificent dark red flowers. The majority of these trees are just bursting into bloom, on a few of them the pods are forming. As yet the beautiful silky fibre they yield has only been employed in stuffing cushions; it is a perfectly smooth polished round tube, and has no hooks like wool, asperities like flax, or ribbon border like common cotton (*Gossypium*) so as to make the fibres cohere when twisted into a thread. We have no doubt but that by some system of inspissating or other chemical treatment, it may be made of value. Next comes the Shameula, or *Eriodendron Anfractuosum*, the *Bombax Pentandrum*. It is described by Graham (p. 17) as an elegant erectgrowing tree, throwing out regular horizontal branches; the flowers drooping, of a white dingy colour. The majority of the trees are fast going out of flower, and getting into pods, the cotton in which the seeds are enclosed being still milky. Under a glass the fibres of the wool seem ribbon shaped and spiral something like the spirals in the stem of the Lotus. It has not yet been converted to any economic use worth noticing. By far the most beautiful of the silk producing trees now in flower belongs to the camphor tree tribe, the *Cochlo-spermum, gossypium* or *Bombax gossypium*, of Roxburgh. It is at present covered with gorgeous bunches of beautiful yellow flowers, about the size of a rupee each flower, with the seed pods bright emerald green about the size of a peach, rapidly expanding themselves. We have another *Bombax* at present worthy of notice, which flowers during the rains—the *Adansonia digitata*, the monkey bread-fruit, or Boabab. There is one of these 24 feet in girth behind the new cotton cleaning premises, a little below the Gun Carriage Manufactory, Colaba, at present being eaten down by the grub of the gigant *Capricorn* beetle, the *Lamea scatis* of Linnæus, which makes such havoc in our Indian Forests. A gigantic Boabab forty-five feet in girth, which grew near the Sanatarium, Colaba, was in 1843 eaten down in a single season by this voracious monster grub.—*Standard, Feb.* 15.

Ten years ago, when the whole of the wood, stored in the great enclosure at Mazagon, occupying the space betwixt the Hope Hall Hotel, the Railway station, the Byculla main road and the shore, was burnt, an attempt was made to convert the vast mass of pure white ashes which remained, into potash. The taste was alkaline, and the conviction was reasonable that wood here, as elsewhere, if completely burnt under exposure to the air would yield potash. It turned out, that in place of this, the whole product of combustion was caustic lime, and this seemed equally to hold good with all trees, whatever their kind. The Aine yields so large a quantity of lime that where the wood is plentiful and limestome at Kunkur scarce it is burnt for comment. The enquiry was pursued in reference especially to trees burned in the jungle, when the results seemed the same. In regard to many of these last, a curious fact transpired; a tree once set on fire, burned leisurely and quietly almost without flame, not only to the extremities of the branches, but underground to the extreme ramifications of the roots, and this occurred in the case of perfectly sound and healthy trees, full of sap, as well as in the case of those that were dead and dry. The conclusion drawn from these results, is that in these cases nitre or some other substance tending to promote combustion, must exist in the sap of the tree. Resolved that these things should be removed from the field of conjucture to that of fact, Dr. Giraud has just commenced a series of experiments, the result of which we hope speedily to see before the world. It seldom happens

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that the core of trees is exactly in the centre; they seem, in Europe, to thicken most rapidly in the direction in which they are most exposed to light and heat. Scotch firs thus exposed, measure twice as much in this direction as in the opposite. From a very limited number of experiments made on seven-year old saplings here, it appears that, in this time, a healthy Casuarina will attain an altitude of 64 feet, and a circumference, a foot above the ground, of 30 inches. At the base, the section has the form of that of a pear cut lengthways, the larger diameter being 10 inches, the shorter 7. Measured across the core, we find the one radius 9½ inches, the other 3, or nearly double that of the Scottish fir. In another tree of the same age 45 feet in length, two feet in girth, the greater diameter was 8 inches, the lesser 6—the larger radius being 5 inches, the lesser 3. Taking the tree in lengths of ten feet from the root, the seven rings seem to continue to the last, the innermost having extended themselves upwards to the very top as the tree grew. But the eccentricity of the core has now greatly diminished, and the stem becomes nearly round—the predominance of the mass continuing on the same side as at the root. These peculiarities are most conspicuous in the *Casuarina*; but they manifest themselves, more or less in all our trees. An Indian Rubber tree planted in 1851, attained a diameter of 7 inches, the core being 4½ inches from the one side and 2, 2½ from the other; the two grew side by side. Very nearly the same law holds good with a Teak and an Accacia. In Europe the thickening is always on the south side of the tree: here, so far as it appears, it is in general mostly due west. In all likelihood the excess of solar heat furnishes the explanation in both cases. North of the Tropics, the sun always shines more or less from the south, and gives out more heat from this, than from any other direction. From the Tropics to the Line, the sun is so nearly vertical, that the mass of heat contributed to a tree or any other body perpendicular to the earth, is from east or west. But from dawn till noon the temperature of the sun is comparatively moderate—it is from mid-day till sunset, that the vast mass of heat is thrown off, the rays shooting from westward. In this direction a tree thickens on the same principle that it expands in Europe to the southward. As these researches are pursued, we trust that they will help to assist us to that marvel of Vegetable life—the silicification or petrifaction of the living trees. We are all familiar with the spongy stony substance called Tabasheer, deposited at the joints of the bamboo. The fact is generally known, that the Teak tree often becomes in part petrified that is the deposition of silica becomes so abundant, as to turn a portion of the trunk into stone, usually resembling the petrified wood of Egypt, Scinde, Goozerat, and Trevicary, &c. In Upper India this is not at all confined to the Bamboo or the Teak—both remarkable for their silicious secretions,—forming in the former a beautiful enamel all over the stem furnishing the sharp points of the leaves, and making the upper surface of the leaves, of the latter eminently serviceable as sandpaper. The Ghunbhar wood found in the Nepaul and Chittagong forests contains such quantities of silica that the carpenter who contracts to saw it by the foot, makes it a condition in his bargain—that it shall contain no stone. The Ebony and Sissoo, and the Sit-Sahl or jungle rose-wood, contain these secretions, though in much smaller quantities. The most mysterious circumstance connected with the specimens from our petrified forests is, that for every atom of carbon or other organic matter that has been removed, an atom of silica has come in its room, the structure remaining so perfect, that under the glass it could not be discovered whether it was a petrified or living specimen we were examining. The experiments of Sir Humphrey Davy shewed that, in Europe, the durability of woods—that is their capacity of remaining uninjured through long lapses of time,—was proportioned to the weight of charcoal yielded by them, and that there were many woods heavy of themselves, that left but a small proportional residuum in the retort after destructive distillation. We doubt if anywhere in Europe a piece of timber can be produced known to have existed 800 years; it would be curious to test the fragments of teak which have formed the supports of the ceiling of the caves of Salsette, which must have been in their places for above two thousand years, and are, therefore, the oldest pieces of timber known to man the mummy cases perhaps excepted.

We fear we may have ventured too far in an attempt to describe an experiment just begun, where the number of facts brought to light is too small for genera-

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lisation; where we confess ourselves to be too slightly acquainted with the subject to feel certain that we may not have given familiar facts as novelties, or even misemployed a familiar and common-place nomenclature. Our object has been, to induce others to come forward and assist in promoting an enquiry which approves itself even to the least informed, as in last degree interesting. It seems to us, little conversant as we profess to be in such things, considering the vast extent, and the extreme fertility of the field, that the aspirants after University honours, could in no way better wipe away the reproach generally attaching to them,—that they could do nothing but learn by rote, imitate or parrot,—than take up for themselves, and carry through unassisted, some branch of enquiry such as that now under consideration, where the facts are within the reach of every one; where sharp and shrewd-witted observation and self-relying originality may easily supply all that is required. They may rely on it, that there are fifty reputations to be made within the island of Bombay by the possession of a little leisure, and a moderate measure of intelligence, observation and reflection.—*Standard, March.*

The following, in reference to the cultivation of Tea in India, may be of interest:—Dr. Jamieson had up to the middle of March despatched 5,300 lbs. to the India House. He had sold about 12,400 lbs. to the public at large, and made over 27,200 lbs. to the Commissariat. So soon as Rohilcund was re-occupied he would have from 17 to 18,000 lbs. ready for the Commissariat, or a grand total of 62, 900 lbs. About five lakhs of seedling plants and 36,000 lbs. weight of seed had been sold in the course of a year to private parties.

APPENDIX D.

HYDRAGRAPHY.

Curious Discovery in the South Atlantic.—The following is the copy of a letter written by Captain Cubins, of the Caribou, belonging to this port, to the Secretary of the Admiralty, relating to a cluster of islands not laid down in the charts, and which lie in the direct track to Australia. The attention of the owners and masters of ships ought to be called to the subject, as many vessels of which no tidings have been heard may have been wrecked on them:—"Ship Caribou, Hobson's Bay, March 13, 1858. I sailed from Liverpool on the 8th December, 1857, bound to Port Phillip, in Australia. On February 22d, wind westerly, brisk gale with snow squalls, at 10 33 a. m. in a clear between the squalls. I fancied I saw land to the southward: took in studding sails, shortened sail, and stood towards it. At 1.30 p.m. hove to abreast the island, in the centre bearing S.S. W., about 12 miles lowered a lifeboat, and sent her to the land. I afterwards stood in to about nine miles off shore, and got no ground with 120 fathoms of line. The island appeared to be in a S.E. and N.W. direction, about 25 miles, its southern extreme trending to the S.W. forming a deep bright on its western side, which was entirely snowclad and gave it the appearance of a great barrier of ice. The greater part of the whole island was covered with snow; there was a remarkable group of high rocks lying off to the N.E from the S.E. part of the island, apparently six or seven miles, and on the N.W. extreme an iceberg aground. The island was cloud-capped, but I think that its greatest elevation could not be less than 450 feet above the level of the sea. While hove to awaiting our boat's return, I was astonished to see vessels at anchor in a bay, we having opened it through drifting to the S.E. One of them got under way and stood towards it; it proved to be the American schooner Oxford, of Fairhaven. They put out a boat, and the master came on board; he told me they called it Kurds Island and that it was discovered by them 18 months before. He seemed annoyed that my boat had landed, and advised me to go and leave her behind, saying she would never return; but I told him I would never leave her while I had another boat to seek for her. I was very anxious, for it was then sundown, and darkness coming on fast; but while speaking the lookout at the masthead reported the boat in sight. He then became more communicative, and told me they were after

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ture be merely considered as a half-way house between Peshawur and Attock.

APPENDIX E.

SHIPWRECKS.

SHIPWRECKS IN THE EASTERN SEAS.—We are informed that the unfortunate man McLean (a native of the Isle of Skye, Scotland), who is believed to have been suffocated on board the burning ship, had been ill for some days, and was in his berth when the fire was first discovered. A comrade went down to him, warned him of the danger, and advised him to come on deck at once. He said he would do so immediately. Afterwards, when it was resolved to batten down the hatches, in order to keep the fire under, it was believed that Maclean was on deck, but in case that any other person should have been left below, repeated calls were made for every one to come up. No response having been heard by those on deck, the hatches were closed. Subsequently, Maclean was missed; it is supposed that he must have been suffocated in his berth.

The Passengers Narrative of the Wreck.—The following vivid narrative of the event has been given to us by Mr. J. Fowler, who was a cabin passenger in the *Eastern City*:

We sailed from Liverpool for Melbourne on the 10th July, having on board upwards of 1,600 tons general cargo, and 160 passengers and 47 officers and crew,—in all, 227 souls. Notwithstanding a long continuance of contrary and baffling winds, we made a very successful passage to the equator, which we passed on the 11th August; and we expected to arrive at Melbourne in seventy to seventy-five days from Liverpool, for our vessel was a swift one, and in capital sailing trim.

On the 21st August, the wind blew strong from the N.E. to the N.W. On the 22nd, it increased to half a gale, with a heavy sea; the vessel rolling about a good deal, and frequently going from twelve to fourteen knots an hour.

On the 23rd, the wind veered round to the SW., but the sea still continued high, and at about 2 p. m. the same day, an alarm of fire was raised, and smoke was seen issuing from the forehatch.

Captain Johnstone, the chief officer, and several of the crew and passengers endeavoured to reach the seat of the fire, which was supposed to be in the forehold, among the cargo; but in a few minutes, the smoke became so dense and suffocating, that we were driven up the hatchway.

The passengers and crew were ordered on deck, and we then believed they had all obeyed the order; but it was afterwards discovered that one of the steerage passengers, named Peter Maclean, belonging to the Isle of Skye, was missing, and he is supposed to have been suffocated in his berth.

The forehatch was then closed, with the exception of holes of about two feet square, one on each side of the hatch, through which passengers and crew proceeded to pour vast quantities of water from the engine pump, and by drawing over the side from sea. For some time the smoke did not appear to increase, and we confidently expected to be able to extinguish the fire, but after half an hour it was evident we were making no progress, and it was apparent our only chance was to endeavour to smother it. For this purpose, the hatch was covered with blankets, shawls, plaid, and everything woollen we could lay hands on, and the forecastle and forward parts of the vessel with old sails.

Meanwhile, the captain had hauled up the courses, and put the vessel before the wind, and had got the boats provisioned and ready to lower away at a moment's notice.

The women and children, about sixty in number, were removed to the poop, where the captain had placed numbers of old sails, carpets, &c., and did everything he could to make them as comfortable as possible under such terrible circumstances.

All that long and dreadful night, both passengers and crew continued to work without intermission pouring tons of water down the hatches and forepart of the vessels; holes were also cut in the deck, and engine-pumps and

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buckets went to work, pouring down water into the hold,—the captain cheering us all the while, and never leaving the deck even for a moment. I could not but admire his calm courage, surrounded as he was on the poop with so many weeping women and children whom he never ceased to comfort by the assurance that they would soon be all safe in the boats.

The majority of the passengers were for a long time ignorant of the full extent of their real danger; but the more intelligent of us knew that we were more than 600 miles from the nearest land, that our boats could not carry more than half of us, and that the sea was so high that no boat could be launched in safety, or if got clear of the vessel could long live, deeply laden as it must necessarily be; our only chance was of being picked up by some vessel,—but we were now far out of the route of all vessels, and we felt that our destruction was simply a question of hours. Still we worked without flinching; but towards morning it became evident that ere long our efforts would be in vain, for, from the smoke now finding its way into the first and second cabins, it became apparent that the fire was working its way aft among the cargo in the afterhold. The doors, windows, &c., of the second cabin were caulked up and the seams of the bulkhead and doors of some of the state-rooms in the first cabin pasted over with newspapers.

The morning of the 24th broke upon us, fortunately, bright and beautiful; but still the sea ran high, still we scudded before the wind, and still we worked hard, with the energy of despair—for now all felt that there was but little hope for us. About noon, the foreyard came down by the run, but fortunately without injuring any one. Many of the passengers and crew were now falling out from the engine and pumps, completely knocked up with the heat, smoke, and incessant work.

During our short spells of breathing time, how eagerly we scanned the ocean! Several times I caught myself looking and fancying that I saw a sail; but it was only the sun lighting up the white crest of a wave. There was evidently no hope for us, and many of us became quite resigned to our terrible fate.

About noon, the smoke and heat had become so great, that we were driven from the top-gallant forecastle, on which we had continued to pour water, and indeed were unable to remain forward of the foremast; the decks also became very hot, and we expected every moment to see the flames burst through the bows; we were also in some dread of the formast giving way which would have precipitated our fate, as in its fall it must have torn up part of the deck, through which the flames would then have burst upon us.

The captain, purser, and myself pitched over bottles containing papers, detailing our position and gloomy prospects; and I, having been wounded in the thighs, by a fall during the night, and feeling the little chance I would have in a scramble for the boats, had bid good-bye to friends and to all the world.

The captain, chief officer, purser, doctor, Mr. Warner, the other chief cabin passenger, and myself, went into the saloon at 2 p. m. to eat something, for we were all becoming faint. We were eating what we believed to be our last meal, but we were all calm and even cheerful,—Capt. Johnstone asking to be excused for the manner in which he was breaking up the preserved salmon, which, with a few biscuits, were to form our dinner, and I for appearing at dinner in such a guise, being literally covered hands and face with tar.

At about 2.30 P. M., and when about to say good-bye in case of not meeting again before the final catastrophe, we were startled with the cry "a sail." I do not know how we all tumbled on deck, but we were there in an instant. How I looked to windward, and how faint and ill I felt when I at first failed to perceive anything but the ocean, and a few black clouds just at the edge of the horizon; how we all at last saw the sail just like a distant gull,—she was coming down upon us, close by the edge of the sun's rays on the sea; how we all cheered and wept, and prayed, and laughed, and clasped each other's hands, and cheered again; how great rough fellows hugged each other, and wept like children; how men, who had probably never prayed before, muttered sincere thanksgivings, and how those who had preserved the greatest indifference when death seemed so near, were now completely overcome, I cannot describe. I shook hands with at least one hundred,—many of them rough, illiterate men, but who had worked with a high courage in the hour of danger, and who were now as sincere in their feelings of thankfulness as the best of us. In less

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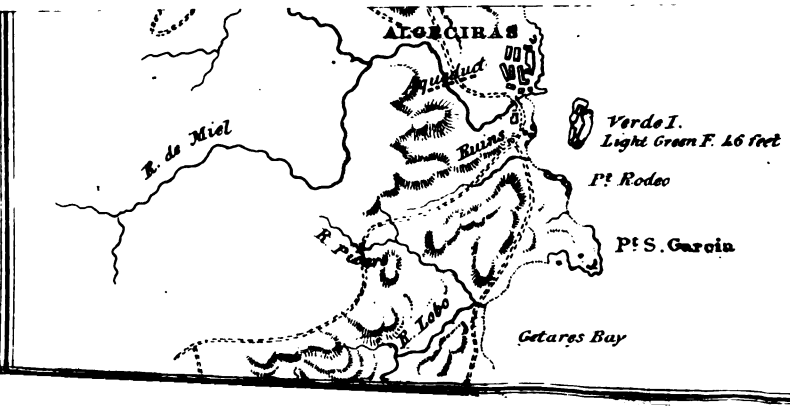

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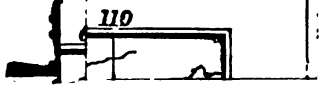

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